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THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S., &c.

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VOLUME XXXI.—1875.

LONDON:
PUBLISHED AT THE OFFICE, BOY COURT, LUDGATE HILL, E.C.
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PRINTED BY WILLIAM CROOKES, CHEMICAL NEWS OFFICE,

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THE CHEMICAL NEWS.

VOLUME XXXI.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 788.—FRIDAY, JANUARY 1, 1875.

ON ATTRACTION AND REPULSION RESULTING FROM RADIATION.*

By WILLIAM CROOKES, F.R.S., &c.

(1). In a paper "On the Atomic Weight of Thallium," presented to the Royal Society June 18, 1872, after describing a balance with which I was enabled to perform weighings of apparatus, &c., in a vacuum, I noted a peculiarity in relation to the effect of heat in diminishing the apparent weight of bodies. I said, "That a hot body should appear to be lighter than a cold one has been considered as arising from the film of air or aqueous vapour condensed upon or adhering to the surface of the colder body, or from the upward currents of air caused by the expansion of the atmosphere in the vicinity of the heated body. But neither hypothesis can be held when the variation of the force of gravitation occurs in a vacuum as perfect as the mercurial gauge will register, and under other conditions which I am now supplying, and which I purpose embodying in a paper to be submitted to the Royal Society during a subsequent session."†

With the vacuum-balance mentioned above I carried out many experiments, but was unable to obtain results which were at all concordant; and it was soon found necessary to investigate the phenomena with smaller and less complicated apparatus.

(2). Most chemical manuals warn beginners against the errors occasioned by weighing substances while hot; and, up to a moderately high degree of exhaustion, I was prepared to find a piece of glass apparatus, when hot, apparently lighter than the weights which should balance it were the whole system at the same temperature. But, instead of the interfering causes diminishing as the rarefaction proceeded, they seemed rather to increase, or at all events to become irregular in their action, sometimes appearing to oppose, and at others to supplement the force of gravity. In such a vacuum as a good air-pump would produce, the actions of the ascending current of air and of the adhering film, it might be presumed, should cease to exert an influence; and I could think of no other disturbing cause except the lengthening of the beam, owing to the heat radiated from the apparatus below it. An increase in the length of the beam should make a mass suspended at its extremity appear heavier; but, whilst I frequently noticed an action which might be due to this cause, I occasionally obtained results which were so anomalous as to convince me that some cause which I had not hitherto recognised was at work (49), and to lead me to hope that perhaps I might succeed in tracing a connection between heat and the force of gravity.

(3). Many physicists have worked on the subject of repulsion by heat. I give here a brief *resume* of the state of knowledge on this subject up to the time of my commencing these experiments, premising, however, that much of this historical information was unknown to me until some of the experiments here recorded were finished and I commenced putting my notes together. The earliest mention I can find is by the Rev. A. Bennet, F.R.S., who in the year 1792 published a paper* on "A New Suspension of the Magnetic Needle intended for the Discovery of Minute Quantities of Magnetic Attraction; also an Air-Vane of Great Sensibility; with New Experiments on the Magnetism of Iron Filings and Brass." Mr. Bennet used a spider's thread as a means of suspension. This he found by experiment to be absolutely free from torsion. I quote the following experiments from his paper:—

"Experiment IV.—A bristle was suspended horizontally by a spider's thread, somewhat stronger than the last, and after turning the wheel till it produced 4800 revolutions, it shortened the thread from 3 inches to 1 inch; yet either end of the bristle would move towards any warm substance which was presented to it either with or against the direction of the twist.†

"Experiment V.—Several other light substances were suspended by fine spiders' threads and placed in a cylindrical glass about 2 inches in diameter, as the thinnest part of the wing of a dragon-fly, thistle-down, and the down of dandelion; of these the last appeared most sensible to the influence of heat; for when this down was fastened to one end of a fine gold wire, suspended horizontally on to one end of two bits of straw joined together in the form of the letter T inverted, it would turn towards any person who approached it at the distance of 3 feet, and would move so rapidly towards wires heated by my hand, as very much to resemble magnetic attraction.

"Experiment VI.—A bottle filled with cold water was brought near the glass cylinder standing in a warm room, and soon after the down of dandelion appeared to be repelled by the bottle by turning away from it. The bottle was removed to the other side, and the dandelion again moved towards the opposite side.

"Experiment VII.—A piece of paper was tied over the mouth of a glass jar, about 4 inches in diameter. Two holes were made in the paper opposite to each other, and

* From the *Philosophical Transactions of the Royal Society of London*, vol. clxiv., part 2.

† *Phil. Trans.*, 1873, vol. clxiii., p. 287.

* *Phil. Trans.*, 1792, p. 81.

† For a re-discovery of this fact, seventy-nine years after, see par. 14.

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near the edge of the glass. The jar was placed upon a table, and suffered to stand a considerable time to cool in a room without fire. I then sat near it on the side where one of the holes in the paper was in the nearer and the other in the farther end of the diameter. I next filled another glass with smoke, and placed it with its mouth over the two holes in the paper. The smoke was now seen to descend through the farthest hole, and mixing with the air in the lower jar, plainly showed that the air moved slowly towards the side of the glass warmed by the heat of my body.

"Experiment X.—To the end of a fine gold wire 3 inches long, and suspended by a spider's thread in a cylindrical glass, was fastened a small circular bit of writing-paper; light was admitted through a small hole, and also the focus of a large lens was thrown upon the paper, with the intention of observing whether it would be moved by the impulse of light; but though these experiments were often repeated, and once with the paper suspended in an exhausted receiver, yet I could not perceive any motion distinguishable from the effects of heat. Perhaps sensible heat and light may not be caused by the influx or rectilinear projection of fine particles, but by the vibrations made in the universally diffused *caloric* or matter of heat or fluid of light. I think modern discoveries, especially those of electricity, favour the latter hypothesis."

(4). In his "Elementary Treatise on Heat,"* Professor Balfour Stewart, F.R.S., cites this experiment of Mr. Bennet's as one of the arguments against the emissive and in favour of the undulatory theory of light and heat. Bearing in mind the overwhelming proofs we now possess that the undulatory theory more nearly expresses the truth than does the emissive theory, it is not likely that the very different results I have succeeded in obtaining (56, 57, 58), by the employment of instruments of a delicacy unattainable eighty years ago, will have any weight in modifying the accepted theories of light and heat.

(5). The next mention of the dynamic action of heat is by Laplace, who, in his "Mécanique Céleste,"† speaks of the "repulsive force of heat" as subsisting among the particles of a fluid, but observes that experiment shows it has no other effect on capillary attraction than what results from its diminishing the density of the fluid.

(6). In the year 1824 Libri‡ published some experiments on the movement of translation experienced by a drop of liquid suspended to a metallic wire, one of the ends of which is heated. This he inferred was due to repulsion produced by the heat between the wire and the particles of the liquid. The Rev. Baden Powell, F.R.S., says‖ that trying to repeat Libri's experiment he has never been able to succeed, except in producing a slight apparent motion in the drop, which seems explicable from the mere effect of evaporation on the side next the heat.

(7). In the *Annales de Chimie et de Physique* for 1825§ are two papers by Fresnel, in which he gives an account of an experiment on the repulsion exerted by heat. To the two extremities of a fine magnetic needle, suspended by a cocoon fibre, he attached vertical disks of foil and mica, so as to test with the same apparatus an opaque and a transparent body, The fixed body which was to repel the torsion-balance was another disc of foil. The whole was covered with the receiver of an air-pump, and a vacuum, up to 1 or 2 m.m., was obtained. The whole was then taken into sunshine, and turned so that the needle was kept slightly out of the magnetic meridian by pressure of the fixed disk against one of the movable disks. On concentrating the sun's rays on either of these disks, they instantly separated, sometimes to the extent of a millimetre. On withdrawing the lens, the torsion-balance only gradually returned to its original position. To see if these phenomena were due to the residual gas, air was gradually let in; and on repeating the experiment when the density of the enclosed air was fifteen or twenty times greater than at first, it was found that the repulsion had not sensibly increased, as it should have done had it been due to currents of heated air. Under some conditions, indeed, the movement was not so great as in a vacuum. Sometimes Fresnel observed an action of attraction, the disks adhering when heated, and separating when the lens was removed. With pieces of copper suspended to the magnetic needle the attraction was very apparent; when the movable and fixed disks were near together, they approached on applying heat. Reasons are given why these effects cannot be due to electricity or magnetism, but the author does not seem to have tried any further experiments.

(8). M. Saigey in 1827* described an experiment with a needle of lead delicately suspended at different distances from a bar of copper. He found the number of oscillations in a given time decrease with the distance. From his experiments he arrived at the following results:—All bodies exert between themselves a feeble repulsive action under ordinary circumstances. A very marked attraction may be observed between a cold and a heated body, or between two bodies of different temperatures, whether screens be interposed or not. Saigey concludes that in many cases results obtained without the appreciable development of magnetism or electricity have been attributed to these forces.

(9). In the year 1834 Professor J. D. Forbes† published an elaborate research on the vibrations which Mr. A. Trevelyan had found to take place between metallic masses having different temperatures. The general conclusion at which he arrived is, that there is a repulsive action exercised in the transmission of heat from one body into another which has a less power of conducting it. These repulsions only take place between bodies having a certain amount of conducting-power, below which some metals fall; it must be excitable in a most minute space of time, and is energetic in proportion to the difference of conducting-power of the substances and to their difference of temperature.

(10). The Rev. Baden Powell, in the same year,‡ published a paper "On the Repulsive Power of Heat." He employed an arrangement somewhat similar to Fresnel's (7), the disks being two small plates of glass with truly plane surfaces. He found that if in the first instance they were pressed together so as to adhere, heat always overcame the attraction, and the movable disks sometimes receded to a sensible distance; but Professor Powell says that this effect (and perhaps also that in Fresnel's experiment) appeared to him in a great measure due to another cause than repulsion, viz., the slight curvature which will be given to the plate of glass by the greater expansion of the more heated surface producing a convexity towards the heat.

(11). By pressing the disks closely together, the coloured rings formed would give a test of the interval between the disks. Professor Powell found that the tints invariably *descended* in the scale when heat was applied, showing that the interval between the disks increased, and proving the existence of a repulsive power exerted between heated surfaces at small, though sensible, distances—the *warping*, or change of figure, if any, in the glasses by heat being readily seen to be such as ought to cause the rings to *enlarge* at the first instant. From experiments made by the contact of a lens with different substances, Professor Powell inferred that whatever tends to increase the rapidity of communication of heat, tends to increase the observed effect. The effect is increased when water, instead of air, is introduced between two lenses.

(12). In 1838 Professor Powell‖ gave some additional notes on the same subject, but no new form of experiment was tried.

* Oxford, at the Clarendon Press, 1866, pp. 161, 352
† *Suppl. Livr.*, x., p. 75, A.D. 1799—1805.
‡ *Mem. Accad. Torrino*, xxviii.
‖ *Phil. Trans.*, 1834, p. 485.
§ Vol. xxix., pp. 57, 107.

* *Bulletin Mathématique*, tom. ix., pp. 89, 167, 239; tom. xi., No. 167. *Bull. Sci. Nat.*, viii., p. 287.
† *Trans. Roy. Soc. Edinburgh*, vol. xii., p. 429.
‡ *Phil. Trans.*, 1834, p. 485.
‖ *Phil. Mag.*, vol. xii., April, 1838.

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(13). Dr. Joule, F.R.S.,* gave an account, in 1863, of a new and extremely sensitive thermometer. It was based upon the disturbing effect of currents of air upon finely-suspended magnetic needles. By diminishing the directive force of the needle, the instrument was made sufficiently delicate to move to the heat radiated from a small pan containing a pint of water heated to 30°, placed 3 yards off, and also to give evidence of the heat of the moon. I have little doubt that these movements were not so much due to currents of air as to the mechanical effects of radiation described in this paper.

(14). It is right that I should mention here that in September, 1871, I received a letter from Mr. J. Reynolds, mentioning that he had constructed a little instrument which would turn to the hand, to a fire, or to any source of heat. It consisted of a thin slip of deal suspended by a filament of spider's web, and enclosed in a thin glass flask. This little instrument was more sensitive than any I had then constructed, as the spider's web was much freer than cocoon-silk from torsion, and Mr. Reynolds kindly allowed me to experiment with it.

(15). I cannot do better, in bringing this historical summary to a conclusion, than draw attention to a passage written in 1868 by Professor Guthrie, F.R.S.,† in which he distinctly points out a probable relation between heat and gravity. He says:—"If the ætherial vibrations which are supposed to constitute radiant heat resemble the aërial vibrations which constitute radiant sound, the heat which all bodies possess, and which they are all supposed to radiate in exchange, will cause all bodies to be urged towards one another."

(16). Were it such a relation between heat and gravity of which I had been getting glimpses, it was evident that a much more delicate apparatus would be necessary to render it distinct, and I accordingly commenced a series of experiments with the view of ascertaining what form of apparatus would be most sensitive to the action sought.

The first requisite was to get rid of the error arising from the expansion of the beam by heat; and since, in working with hot bodies, the metallic masses used as weights would themselves become warm, and since the action I sought to establish was only likely to be due to a *difference* in temperature between the hot body on one arm of the balance and the cold weights on the other arm, both being under the influence of the same force of gravity, I endeavoured to obtain the desired results by means of a spring-balance, one in which the variations of gravity should be measured, not against gravity itself, but against the tension of a spring.

(17). I tried many forms of spring-balance, and obtained with them results which, at the time, I thought sufficiently satisfactory. The sources of error were, however, so numerous, and the manipulation was so difficult, that I ultimately gave up that form of balance in favour of the one usually employed.

In order to obtain a very high degree of rarefaction, without the trouble and uncertainty attending the use of an ordinary air-pump, it was necessary to have the balance sufficiently small to enable it to be exhausted by the Sprengel pump.

Before proceeding to the forms of apparatus finally adopted, and the experiments made therewith, it will, I think, be useful, for the sake of other experimentalists, if I briefly describe some of the arrangements successively tried and rejected, with the reasons for so doing.

(To be continued.)

Procedures for Determining Thein in Tea.—M. R. Weyrich has made a comparative investigation of the methods proposed of Mulder, Peligot, Claus, Zoeller, and Liventhal, and gives the preference to the first-mentioned.

* CHEMICAL NEWS, vol. vii., p. 150.
† *Proceedings of the Royal Society*, vol. xix., p. 35.

LECTURES ON THE MORPHOLOGY OF CRYSTALS
AT THE
CHEMICAL SOCIETY.

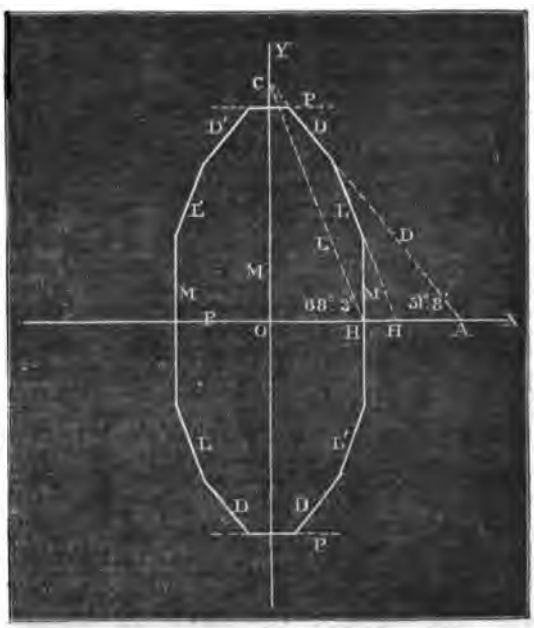
By NEVIL STORY MASKELYNE, M.A., F.R.S., &c.

I.

THE lecturer, after defining crystallography as the science dealing with chemical morphology, took in hand a large crystal of apophyllite, and pointed out that its faces were of three kinds, and that those of each kind were symmetrically disposed; the similarity of the faces of each kind being at once recognisable in the nature of its surface and physical features no less than in its form. A group of such similar repeated faces he designated as *a form*. The repeated morphological features of a crystal are its faces, its edges, and its quoins (or solid angles). It was seen that the *faces* belonging to either of the three forms on the crystal of apophyllite differed in magnitude; whereas the repetition of an *edge* implies absolute constancy in the dihedral angle so repeated.

This result, of equality in the edge-angles, brings the crystal under the domain of number—makes it, in short, an exact science.

A crystal was defined as a system (*σύστημα*) of molecules belonging to an individual substance, symmetrically arranged, and presenting the same properties along all lines taken parallel to the same direction, or to directions that are similarly disposed in respect to symmetrically-



repeated features. The properties and external characters that distinguish the faces of one form from those of another were treated as the results of properties in the crystal; such, for instance, as the character of its cohesion perpendicularly to the face. Where faces are parallel to cleavages, the directions of least cohesion are perpendicular to such faces.

The first subject for consideration is the mode of measuring an edge, by determining, in one form or other, the angle made by two lines meeting in the edge perpendicularly to it; of which lines, one lies in each of the planes.

The kinds of goniometer in use for measuring angles were alluded to in passing; and the lecturer went on to

take the case of four faces of a crystal of barytes, which he exhibited. These faces had all their edges parallel, and so served to define *a zone*. Supposing a section to be made through the crystal perpendicularly to all these planes (and so to their edges), he gave a profile view of this section, which he termed the *zone-plane* of the zone of the four faces, M, L, D, P.

The method of employing two fixed lines (in this case perpendicular to each other) as axes to which the faces should be referred, was then explained; and, as the planes M and P were at right angles, their profile lines, or "traces," on the plane of the zone (the plane in which the figure was drawn) were taken for the directions of the axes X or Y; but lines parallel to them, passing through a point, O, inside the crystal, were actually taken for the axes. On the line P, *i.e.*, the axis X, the line L (representing the plane L) forms an angle of 68° 3', the line D making with that line an angle of 51° 8'. To compare these planes, lines parallel to the lines L and D were made to pass through the same point, C, on the axis Y; and then we have—

$$\frac{OC}{OA} = \text{tangent } 51° 8' = 1{\cdot}24079,$$

$$\frac{OC}{OH} = \text{tangent } 68° 3' = 2{\cdot}48132,$$

as found by calculation from logarithmic tables.

Hence $OC = 1{\cdot}24079 \times OA = 2{\cdot}48132 \times OH$,

And $\frac{OA}{OH} = \frac{2{\cdot}4813}{1{\cdot}2407} = \frac{2}{1}$ very nearly.

The numbers being more nearly 2 : 1, in proportion as the angle to be measured allows more precise determinations of the value of the angles.

If we represent OA, OC, OH by a, c, $\frac{a}{2}$, respectively,

the ratio of $OC : OA = \frac{c}{1} : \frac{a}{1}$

$$OC : OH = \frac{c}{1} : \frac{a}{2}.$$

Treating the zone as thus represented, merely by lines which are the traces of faces in the zone on a plane, we may say that the ratio of $a : c$ is the parametral ratio, a and c being the parameters of the zone, as referred to M and P as axes; and the numbers by which these parameters have to be divided for each plane are called the *indices* of the plane—1,1 being the indices of D, 1,2 those of L, and these, bracketed, give symbols (1,1) and (1,2) for symbols of the planes, as referred to two axes parallel to the traces of two planes in the zone.

(To be continued).

ON THE EFFECT OF HEAT ON IODIDE OF SILVER.*

By G. F. RODWELL, F.R.A.S., F.C.S.

(Concluded from page 280.)

It has been before stated that at the moment of solidification of a mass of iodide of silver a considerable contraction takes place. The following experiments were made in order to determine the amount of this contraction. A copper tube, which contained 105·548 grammes of mercury, was found to contain 42·080 grammes of iodide in a molten condition (say 450° C.), that is a little above the fusing-point of the iodide. This would give as the specific gravity of the molten iodide 5·406. The mass was then allowed to solidify in the tube, and a large conical cavity appeared at the moment of congelation. This cavity contained 4·552 grammes of mercury, and would contain 1·8149 grammes of iodide. Hence, if the volume of the iodide before fusion be taken as 100, the volume of the resulting fused iodide will be 104·499. Or, again, 100 volumes of molten iodide contract to 95·694 volumes of the solid. If the volume at the point of maximum density (116° C.) be taken as unity, the volume of the molten iodide will be 1·04499. The principal expansion takes place at the moment of fusion, and the expansion between 116° C. and 450° C. is not considerable. No really satisfactory method has been yet found for determining the coefficient of expansion between 116° C. and 145° C.; but if we assume it to be equal to the mean expansion on the other side of 116° C. (of course omitting the sudden expansion which takes place when the amorphous passes into the crystalline condition,) we find that a volume 1·0 at 116° C. will become a volume of 1·01455238 at 450° C. just below the melting-point, while in passing from the solid to the liquid condition the volume increases from 1·01455 to 1·04499, an expansion = 0·03044.

When a mass of iodide of silver passes from the amorphous into the crystalline condition the molecular commotion is so considerable that portions of the mass are sometimes jerked off from the ends of a bar, and large fissures appear in the mass. These are sometimes as much as half a millimetre broad and several centimetres long in a cylindrical mass, weighing from 10 to 20 grammes. They penetrate to the centre of the mass, as may be shown by cooling the iodide under mercury, when the whole mass is found to be permeated by the metal. The capacity of these intercrystalline spaces was determined by allowing a known weight of iodide to pass from its amorphous to its crystalline condition beneath the surface of mercury, and again weighing.

α. 3·643 grammes AgI after thus cooling weighed 3·968 grammes.

β. 5·913 grammes AgI after thus cooling weighed 6·417 grammes.

And as we know the specific gravity of mercury and of the iodide, it is easy to deduce from the above that the volume of the cracks is represented respectively by (*α*) 0·1353 gramme and (*β*) 0·2098 gramme of iodide; hence—

α.	3·643	:	0·1353	: :	100	: 3·7112
β.	15·913	:	0·2098	: :	100	: 3·5481

which give a mean of 3·6296. Therefore 100 grammes of iodide in the amorphous condition produced, in passing into the crystalline condition, intercrystalline spaces capable of containing 3·6296 grammes of iodide. From an observation which was made on a cylindrical mass of iodide a centimetre diametre, which in undergoing expansion in the passage from the amorphous to the crystalline condition had produced a separation amounting to half a millimetre in a tube which had yielded to the expansion, the expansion of the mass, *plus* the intercrystalline spaces within it, was found to be 0·047619; hence a volume of amorphous iodide represented by unity, becomes a volume of 1·047619 in passing into the crystalline condition, *plus* the intercrystalline spaces; and the volume of these spaces having been determined above, we find that the actual change of volume which takes place simultaneously with the change of molecular condition amounts to 0·011323; that is, a volume of iodide at its point of maximum density (116° C.) represented by unity, becomes a volume of 1·011323 in changing to the crystalline condition.

Frequent fusion and cooling appear to render a mass of iodide more brittle and crystalline, and to promote the formation of large fissures. The iodide prepared by dissolving silver in hydriodic acid and subsequent fusion,

* A paper read before the Royal Society.

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was less brittle than that produced by precipitation and frequently fused. We have before noticed that while the latter passes into its crystalline condition at a temperature ranging a few degrees on either side of 116° C., the former may sometimes be cooled to much lower temperatures without change. In fact it appears to be altogether more compact and horny, and almost free from intercrystalline spaces than the fused iodide produced by precipitation. The specific gravity appears also to be slightly higher. Boullay found the specific gravity of the fused iodide produced by precipitation to be 5·61, but he was probably unaware of the presence of the intercrystalline spaces, or he did not take special precautions to obviate them. An ordinary fused mass of iodide was found to have a specific gravity of 5·545, when no precautions were taken to dislodge the air from the intercrystalline spaces. Now we have before given reasons for believing that a volume of iodide at its maximum density (116° C.) becomes a volume of 1·047619 in changing to the crystalline condition; and if we take the specific gravity to be 5·816 at the maximum density, we deduce the specific gravity in the crystalline condition, not taking into account the intercrystalline spaces, to be 5·561,—

1·0476 : 1 :: 5·816 : 5·561,

a number which differs by only 0·016 from the specific gravity found by direct weighing, when no precautions were taken to dislodge air from the intercrystalline spaces. When, however, the mass of iodide was boiled for a length of time in water and cooled in a good vacuum, the specific gravity at 0° C. was found to be 5·681. Deville found it under the same conditions to be 5·687*. The specific gravity of the molten iodide has been shown above to be about 5·406, and the specific gravity at the point of maximum density of the amorphous iodide would appear to be 5·8167. This applies to the precipitated iodide which had been several times fused, and with which the principal experiments herein described were made. A specimen of iodide produced by the direct solution of silver in hydriodic acid gave a specific gravity of 5·812, and appeared to be less crystalline, and more compact than that produced by precipitation. Deville found the specific gravity of the unfused precipitated iodide to be 5·807, and of the fused iodide 5·687, while Damour found the native crystals to have a specific gravity of 5·667, hence the amorphous precipitate has a higher density than either the fused crystalline iodide and their native crystals. Thus the density of the amorphous precipitate coincides almost perfectly with the density of the fused iodide at its point of maximum density (116° C.) when in the amorphous condition, as deduced from the above experiments.

If we place in a specific-gravity flask a quantity of fused iodide of silver, fill it up with mercury (taking every precaution to displace the air from the intercrystalline spaces), and place in the ground neck of the flask a perforated stopper continued as a capillary thermometer stem, we have obviously a thermometer in which we can observe the effect produced by the anomalous contraction of the iodide on the regularly expanding mercury. On applying heat to such an arrangement we observe that for a while the mercury rises in the stem, until on further heating the contraction of the iodide exceeds the expansion of the mercury, and the column retreats if much iodide is present into the very bulb of the instrument.

If the heating be now discontinued the mercury slowly rises as the iodide cools, until the contraction of the mercury exceeds the expansion of the iodide, beyond which point the mercury continues to sink as the bulb cools. Nothing could better illustrate the complete inversion of the effects usually produced by heat on bodies in the case of the iodide of silver.

Professor Guthrie suggested to me that a convenient method of determining the amount of contraction produced by heat in the iodide, would be to fill a specific-gravity flask with mercury, and determine the amounts of mercury exuded from the flask for every ten or twenty degrees of temperature; then to place in the flask a known weight of fused iodide with a known weight of mercury, and repeat the determinations. This was accordingly done. About 440 grammes of mercury were employed, and weighings made at intervals of a few degrees. The method was found to be satisfactory, and the results concordant. For example (to take a few instances from many), the amounts of mercury driven from the flask by expansion for 10 C. were found to be as follows.—

Between	29° C.	and 53° C.	.. 0·066062
,,	22° C.	,, 74° C.	.. 0·067250
,,	20° C.	,, 84° C.	.. 0·067390
,,	29° C.	,, 86° C.	.. 0·068526
,,	47° C.	,, 84° C.	.. 0·069297

Numbers which, when the necessary corrections have been made for the expansion of the glass, agree very well with Regnault's determinations of the absolute expansion of mercury. Then 38·3680 grammes of the fused iodide were placed in the flask; it was filled up with mercury, the whole was heated, cooled in a good vacuum, weighed; cooled to −18° C. (−0·4° F.) and weighed. The flask was then heated respectively to 0° C., 21° C., 67° C., and the weights determined. At high temperatures the mercury acts upon the iodide and a green iodide of mercury is formed The results were not very concordant above 67° C. and have not been introduced. The general results were as follows: the amounts of mercury driven from the flask for 1° C. were respectively:—

Between	−18°	and 0° C.	= 0·052648
,,	−18°	,, +21° C.	= 0·051392
,,	0°	,, +21° C.	= 0·050285
,,	−18°	,, +67° C.	= 0·049684
,,	0°	,, 67° C.	= 0·048873
,,	+21°	,, 67° C.	= 0·048228

Now from the known weight of mercury in the flask and the known expansion of mercury, it is easy to deduce the quantity of mercury which ought to have been driven from the flask by expansion for any number of degrees; and having determined the actual amount of mercury expelled, we at once find the contraction of the known weight of iodide of silver from known number of degrees, by subtracting the amount of mercury expelled from the amount of mercury which ought to have been expelled if the iodide had not been present. We can thus arrive at the coefficient of contraction of the iodide for one degree Centigrade. These appear to be 0·00000718 for temperatures between −18° C. and 0° C., 0·00003297 for temperatures between 0° C. and 21° C., and 0·00005570 for temperatures between 21° and 67° C. Thus the coefficient augments with the temperature.

We have endeavoured to prove in the foregoing pages the following main facts:—

1. That the iodide of silver exists in three allotropic forms, viz. (α) at the temperatures between 116° C. and its fusing-point, as a plastic, tenacious amorphous substance possessing a reddish colour, and transparent to light; (β) at temperatures below 116° C. as a brittle, opaque, greenish-grey, crystalline mass; and (γ) if fused and poured into cold water, as an amorphous, very brittle, yellow, opaque substance.

2. That the iodide possesses a point of maximum density at or about 116° C. at the moment before passing from the amorphous into the crystalline condition.

3. That if we allow a mass of molten iodide to cool, the following effects may be observed:—(α) at the moment o solidification a very considerable contraction takes place (β) the solid, on further cooling, undergoes slight and regular contraction after the manner of solid bodies in general, until (γ) at or about 116° C. it undergoes sudden and violent expansion, passing from the amorphous into the crystalline condition; (δ) after undergoing this expan-

* "Sur les Propriétés de l'Iodure d'Argent," *Comptes Rendus*, vol. lxiv.

sion the mass on further cooling undergoes slight expansion, and (ϵ) the coefficient of contraction diminishes as the temperature decreases (or otherwise expressed, the coefficient of contraction augments with the temperature.)

I must in conclusion express my great indebtedness to Dr. Guthrie for allowing me to carry out many of the foregoing experiments in the Physical Laboratory at South Kensington.

NOTE ON M. VILLE'S EXPERIMENTS, SHEWING THE ASSIMILATION OF CERTAIN NITROGENOUS SUBSTANCES BY PLANTS.

By Dr. CHARLES A. CAMERON.

I HAVE read M. Ville's experimental results in relation to the assimilation of certain nitrogenous matters by plants with great pleasure; they are of the highest degree of interest and importance.

I wish merely to recall to mind that which M. Ville does not appear to be aware of, viz., that in a paper which I read before the British Association, in 1857, I proved that urea was as effective as ammonia in supplying nitrogen to plants. This paper was published *in extenso* in the *Chemist*, November, 1858, and several other journals, including the Paris publication, *Repertoire de Chimie Pur et Applique*, December, 1858.

M. Ville's statement, that plants cannot assimilate nitrites or phosphites, is interesting; but it is in harmony with the observation made early in this century by De Saussure, viz., that plants cannot assimilate the carbon of carbon monoxide, though they can that of carbon dioxide. In 1857, I found that plants could not assimilate the nitrogen of cyanogen gas, but that they were to some extent benefited by the application of cyanide of potassium. M. Ville appears to consider that cyanide and ferrocyanide of potassium exercise only an injurious influence upon vegetation; but my experience in this matter has been different to M. Ville's. I believe that these compounds, applied in small quantities, and in combination with other nitrogenous substances, to plants, aid their growth.

Apropos of ferrocyanide of potassium, I find in the *Proceedings of the Royal Irish Academy* for January 8, 1844, an account of experiments made by the Rev. Thomas Knox, showing that ferrocyanide of potassium produced as great an increase in the yield of a grass crop as the salts of ammonia.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 1, 1874.

Rev. WM. GASKELL, M.A., Vice-President, in the Chair.

"*Some Doubts in regard to the Law of the Diffusion of Gases*," by HENRY H. HOWORTH.

The author said that he had a difficulty in reconciling the conclusions drawn by Dalton, Berthollet, and Graham respecting the diffusion of gases with the actual facts of nature, and it seemed to him that the only way in which the inferences drawn from experiments in the laboratory and what was going on in nature on a large scale could be reconciled was in the belief that either diffusion was extremely slow in some cases, or that it was sometimes prevented.

He argued that the continuity of condition between gases and liquids which had lately been so admirably illustrated made it, *a priori*, probable that similar laws prevailed in both classes of matter in respect to their laws of diffusion, &c., and that, as in the case of liquids, the law of diffusion was not a universal one, but had at least apparent exceptions, so also among gases there might occasionally be conditions which resisted or very greatly impeded the operation of the law. He granted at once that the gases that form air, and many others, bear uniform testimony to the correctness of the generalisation; but in the case of carbonic acid, watery vapour, and hydrogen, there seemed to be some room for doubt. The fact that in all abandoned wells, tunnels, and mines, where atmospheric currents do not play, and where there is no absorbing vegetation, there is an accumulation of carbonic acid gas, although these hollows have ample access to the air, goes to show that the rate of diffusion must be exceedingly slow in these cases, if in fact diffusion be not actually suspended. The mephitic vapours in low valleys in volcanic districts, and the gases that generate malaria in many low-lying marshy districts—such as the Maremma in Italy, the neighbourhood of Montpelier in France, &c.—seem to point in the same direction. The very diverse condition in regard to the amount of watery vapour contained in contiguous areas of the atmosphere, whether we examine it in different neighbouring localities or in the superimposed strata of air in any particular locality, show that the working of the law of diffusion is here greatly impeded. In regard to hydrogen the evidence is somewhat different. It is clear that if under certain conditions hydrogen be an exception to the general law of the diffusion of gases, and follows rather the more general law of gravitation, that it will exist in a stratum above the atmosphere and beyond the reach of direct observation. In his experiment upon the occlusion of gases Mr. Graham examined several aërolites, and found that under the air-pump they parted with a very large quantity of occluded hydrogen. If, as is probable, the gas was occluded by the aërolites when at a red heat, and this red heat was coincident with their passage through that layer of the upper atmosphere in which the phenomena of shooting stars and of the aurora occur, it seems more than probable that this stratum is a layer of hydrogen. This is confirmed by what we know of the spectrum of certain auroras, which resembles those of the zodiacal light and the solar corona. The spectrum of the corona has been the most attentively studied, and Janssen, perhaps the greatest authority on it, speaks most confidently about its distinguishing feature being the hydrogen lines, while a special line which characterises both its spectrum and that of aurora, and which is different to that of any terrestrial substance, is considered by Father Secchi to be an abnormal hydrogen line. Dr. Dalton long ago argued, as Mr. Baxendell has reminded Mr. Howorth, that the peculiar features of the aurora could best be explained by the hypothecation of a stratum of some peculiar gas above the atmosphere. A gas of a "ferruginous nature" is the expression of Dr. Dalton. Now hydrogen in the higher chemistry is not only classed among the metals, but Faraday and others have shown that in its relation to magnetism it is nearly allied to iron, so that a stratum of hydrogen above the air would seem to exactly answer Dr. Dalton's postulate. If it should exist, the earth would resemble the sun in one remarkable feature, for we now know that the sun is girdled with an immense layer of hydrogen. Lastly, he would add that the heterogeneous texture of the gaseous nebula, like the great nebula in Orion, seems to argue that the law of the equal diffusion of gases does not prevail there.

Mr. Howorth presented these facts with considerable hesitation, his excuse for doing so being his view that all physical laws are tentative only; that is, they are good as long as they explain all the facts, and no longer, and that it sometimes becomes a duty to present apparently aberrant and abnormal facts to an audience so well quali-

fied to criticise them as the Manchester Literary and Philosophical Society, in order that they may either be brought within the law or that the law may be revised.

NOTICES OF BOOKS.

Alkali Act, 1863. Tenth Annual Report by the Inspector of his Proceedings during the year 1873.

DR. R. ANGUS SMITH has presented the authorities and the nation with another of his most instructive reports on the working of the Alkali Act. Whilst pointing out the very satisfactory circumstances that "the work" (condensation of muriatic acid gas) is gradually being done with more exactness, he thinks that the time is come when the Act may be improved without injury to the manufacturers, and with manifest benefit to the general public. The law at present requires that a certain per centage of the gas generated,—as calculated from the salt decomposed,—shall be condensed, but takes no note of the degree of concentration or dilution of the remaining portion. Dr. Smith suggests, therefore, that an additional standard shall be enforced, to the effect that the gaseous mixture escaping from the chimneys "shall not contain above a certain amount of acid per cubic foot." The present average is found to be 0·16 grain per cubic foot. The Inspector has reasons for believing that the evil is done chiefly by those above this average, and proposes that a maximum of 0·2 grain shall be adopted, "to be diminished gradually by the Local Government Board, as circumstances showed it practicable, by 0·02 at a time and annually till it reached 0·1." He suggests also that the other gases, *e. g.* sulphurous acid, oxides of nitrogen, &c., shall be put under inspection, and their treatment by the best known methods demanded. To these proposals no reasonable objection can be raised. The original Act was tentative, and having succeeded to a certain extent, we are encouraged to go further. If we take the whole kingdom into consideration, there can be no doubt that sulphurous acid, as evolved from imperfectly managed lead chambers, from roasting sulphuretted ores, from "stoving" woollen goods, and most of all from the combustion of coal, does far more mischief to vegetation than the merely local escape of hydrochloric acid. It is, therefore, of the highest importance that serious attempts should be made for the abatement of the nuisance. Something has already been done. Many metallurgical establishments which formerly allowed the whole of the sulphurous acid evolved to escape into the air, now convert a part at least into sulphuric acid. The most striking result on record is that obtained at Mulden, near Freiberg. There, in 1864, only 18,000 cwts. of sulphurous acid were converted into sulphuric acid. But now the proportion has risen to 49,320 cwts. converted into sulphuric acid, or 42 per cent. of the gross amount. Dr. Smith informs us that he has not "heard of any equal result obtained in England at any metallurgic works."

But the main amount of sulphurous acid evolved is due merely to the combustion of coal in dwelling-houses and manufactories, and we feel, therefore, bound to ask if nothing is to be done in this direction? It is instructive, in this respect, to compare the atmospheres of London and of Manchester. We have smoke enough in the metropolis, but the trees in our parks and squares are luxuriant in comparison with the vegetable hobgoblins withering in the outskirts of the northern city. "The air of Manchester," says our author, "will allow no plants to grow. I am persuaded that it is the acid that is the main cause." The reason of the excess of acid in the air of Manchester is that the Lancashire coal is very rich in sulphur. Now it is obvious that smoke consumption, commonly so-called, cannot reduce the evil. The more perfectly we burn a ton of coal, the more certain it is that all the sulphur present is oxidised. Our only hope lies in minimising the consumption. If we find that one steam-engine proprietor can obtain a certain amount of power with a certain consumption of coal while his neighbour requires only half the quantity, we must compel the former to do likewise.

The results quoted from Prof. Stockhardt and the members of the Saxon commission appointed to examine the action of metallurgical fumes upon agriculture are very interesting. They find that "the trees first injured are the conifers; then the willow and the birch; acacias, alders, and oaks stand better, and still more the poplars and elms. Among fruit trees the sweet cherry, nut (probably walnut), and plum trees go early; the apple remains longer; pear and mulberry trees stand still better. Among bushes the order is whitethorn, rose, currant, and vine; the gooseberry and raspberry suffer less, and the mulberry hedge, quince, privet, and elder suffer least." This comparative order agrees pretty well with what has been observed in England. The inability of the rose to tolerate a smoky atmosphere is well known.

For further valuable information as to the effects of sulphurous acid and coal smoke in general upon vegetation we must refer our readers to the report itself.

The influence of the fumes of chemical works upon animal—and in particular upon human—life, has also been made the subject of enquiry. Dr. Smith has been unable to find satisfactory evidence in favour of the not uncommon notion, that acid vapours are a protection against zymotic diseases and against certain pulmonary affections.

In conclusion we feel bound to give our hearty testimony to the value of the services which Dr. Smith, in his capacity as inspector under the Alkali Act, is rendering to the nation. If the Act is successful the result is mainly due to his zeal, tact, and intelligence. His method has been to lead, not drive, the interests affected. He does not seek to lay down at once a hard and fast line, but as a truly practical man he aims at and effects gradual improvement. We can wish nothing better for the cause of sanitary reform than that all inspectors who have to deal with "standards" may sit at his feet.

Des Produits tires du Pin Maritime. Essai theorique et practique sur la Fabrication des Matieres Resineuses. Par PAUL CURIE. Paris: Eugene Lacroix.

AN interesting account of the products obtained from the maritime pine of the Landes of south-western France. Among these the author enumerates, besides timber and charcoal, acetic acid, wood-spirit, tar, illuminating gas, cellulose, applicable in the paper manufacture, oil, fat, crude turpentine, essences, rosins, pitch, resinous oils, and lamp-black. Some of these products are complex mixtures not as yet thoroughly examined, either from a theoretical or a practical point of view. To these the author especially calls the attention of chemists, as it is far from improbable that they may prove capable of new and important applications.

The processes at present in use for obtaining the products above mentioned are carefully described, and the work is accompanied with illustrations of plant and apparatus, and with a map of the district. One coloured plate shows the successive shades of resins and pitches from "extra-resin" of the palest straw-yellow, bordering upon white, to the *brai-noir*, black pitch, of an earthy-brown colour. From colophene—a liquid remarkable for its dichroism—he suggests the possibility of obtaining colouring matters.

The Journal of Materia Medica. Conducted by J. BATES, M.D., and H. A. TILDEN. New Lebanon, N.Y.: Tilden and Co.

THE most interesting point in this little journal is a statement by Dr. Duff Child that malaria is a definite chemical compound, consisting of carbon, nitrogen, and hydrogen, and capable of existing free or combined. The editors, like ourselves, feel somewhat sceptical as to this new theory, and would like further evidence.

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CORRESPONDENCE.

COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

Sir,—The curt letter (Chemical News, vol. xxx., p. 294) in which Messrs. Pickford and Winkfield complain of discrepancies between certain analyses, gives us no assurance of he identity of the samples submitted to A, B, and C. The accordance which might be expected between the results of analysis can only be judged of when the means are known which were taken to render the mass furnishing the samples perfectly homogeneous. The case would also have been more fully presented to your readers if Messrs. Pickford and Winkfield had stated what fees A, B, and C received for the analyses in question. The fees paid for commercial analyses are often such as to make it simply impossible for the analyst to attempt scientific accuracy. None but persons who have themselves worked at exact chemical determinations have any idea of the amount of delicate manipulation, exact observation, time, and patience required for an accurate and complete analysis of such substances as those referred to in your correspondents' letter. If fees are paid which entirely put out of the question the expenditure of all this time and attention, rough and ready methods are necessarily adopted. Such methods usually suffice for commercial requirements, and although even these imply on the part of the chemist skill acquired only by long training, the remuneration he receives is absurdly small when compared with that earned in other professions. It appears to me that the means to be taken to prevent the "frightful discrepancies" complained of are very obvious and entirely in the power of the commercial world. When the analyst's fees are made at least equal to those paid to the accountant, the actuary, or the lawyer, for a comparable amount of skill and attention, we shall hear no more pathetic laments over losses through the inaccuracies of chemical analysis.—I am, &c.,

R. Routledge.

London, December 30, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 22, November 30, 1874.

Distribution of Bands in Primary Spectra.—M. G. Salet.—The question of the existence of double spectra seems at present answered in the affirmative. A few years ago the Swedish physicist, Angström, in his celebrated memoir on the solar spectrum, pronounced the opinion of Plücker, according to which an elementary body might give different spectra at different temperatures, decidedly incorrect. Yet in his last work he declares himself unwilling to deny that a simple body, when brought to the gaseous state by heat, may not, in some cases, give different spectra. An element may form with another element a chemical compound giving a particular spectrum, and in like manner the same element may form compounds with itself—isomeric compounds which, if not destroyed by heat, may give each its peculiar spectrum. This is the opinion which the author has maintained, supporting it by various experiments made, not only with Geissler's tubes, but also taking advantage of the absorbent properties of certain vapours, such as sulphur, bromine, and iodine. The spectra with bands, or primary spectra of the simple bodies, seem absolutely similar to the known absorption-spectra; those, for example, of iodine and bromine, which no one has thought of ascribing to compounds. The author has to point out a new point of resemblance between these two sorts of spectra. It is known that Thalen, in a work on the absorption-spectrum of the vapour of iodine, has concluded that the various bands of this fluted spectrum are not equidistant; they form several intermingled series, and in each of these the respective distance of the consecutive bands varies with the length of the wave, following a law which differs little for adjacent series. The study of the primary spectrum of sulphur has led the author to similar conclusions.

Letter of M. Schnetzler to M. Dumas on Viticulture.

Letter of M. Max Cornu to M. Dumas on Viticulture.

Heat Disengaged by the Combination of Hydrogen with Metals.—M. J. Moutier.—M. H. Sainte-Claire Deville, comparing the phenomenon of dissociation with that of evaporation, has indicated the course to be taken in the application of thermo-dynamical formulæ to the study of dissociation. The formula deduced by Clausius from Carnot's theorem for changes of aggregate condition applies to dissociation. If we call L the heat of combination of two bodies of the absolute temperature, T, under the pressure, p, equal to the tension of dissociation of the resulting compound at this temperature; v the specific volume of the dissociated elements; v' the specific volume of the compound in the same conditions of pressure and temperature; A the calorific equivalent of the work done, then—

$$L = AT(v - v')\frac{dp}{dT}$$

This formula permits us to determine the heat of the compound L, when we possess a table of the tensions of dissociation of the compound at different temperatures. The heat liberated by the combination of hydrogen with potassium and sodium increases at first with the temperature and then decreases, so that the heat of combination of hydrogen with the alkaline metals passes its maximum within the limits of the temperatures observed. The combination-heat of hydrogen with sodium is notably superior to that of hydrogen with potassium. At a temperature of 330°, calculation gives for potassium L = 9300 calories, and for sodium L = 13000 calories.

Laws of Double Interior Reflection in Bi-refringent Uniaxial Crystals.—M. Abria.—If the two rays, ordinary and extraordinary, into which a ray of light is divided when it enters a donble refractive prism, are reflected by one of the lateral faces, each of them is split up by the act of reflection, and we obtain in general four images. The theory of undulations permits us to determine the direction of each of these reflected rays, and the author has undertaken to verify the laws to which it leads. In the case first examined, the axis of the quartz prism was parallel to one of the planes, and, moreover, perpendicular to the edges. The ray falling upon the plane of entrance normally to that plane gives two rays, but each of the latter only furnishes one by reflection. One of them has undergone the ordinary refraction and reflection, and the other the extraordinary. They may be designated OO', EE'. The author has calculated according to the theory the angle which the definitive emergent rays should form with each other, and has compared it with that found by observation. The agreement is complete.

Decomposition of Certain Salts by Water.—M. A. Ditte.—(See *Comptes Rendus* for October 19 and 24, 1874.) The author has experimented on the double sulphate of potash and lime, $2(SO_3,CaO),SO_3KO,3HO$. He comes to the following general conclusions:—The salts examined are decomposed by water, according to laws well known and alike in all cases. There is formed a sparingly soluble product (a sub-salt, or sulphate of lime), and the water takes up free acid or sulphate of potash. For each

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temperature there exists a liquid of such composition that according as the concentration is varied in one or other direction there takes place either decomposition or re-constitution of the primitive salt; and whatever may be the point of departure, the direction of the phenomenon is always such that the liquid returns to this composition. The decomposition appears independent of the quantity of undecomposed salt which the liquid contains, of the undissolved quantities of its elements which are there found in a state of mixture, and also of the nature of the acid or saline substances which it may contain if these substances have no chemical action upon the salt in question or upon its constituents. It may not be without interest to bring these results into connection with the laws established by M. Sainte-Claire Deville for the dissociation of bodies by heat, laws which seem applicable to these phenomena. We need not be surprised at this analogy if we compare the action of heat and that of a solvent upon the same compound. The quantity of heat needful to produce a change of state is always the same whether this change takes place in the hot way or in the way of solution. It appears, therefore, natural that certain decompositions may be effected by the direct action of fire, or by the intermediation of a liquid, following analogous rules in both cases.

Product of Addition of Propylen to Hypochlorous Acid.—M. L. Henry.—Noticed elsewhere in the CHEMICAL NEWS.

Influence of Boiling Distilled Water upon Fehling's Test.—MM. E. Boivin and D. Loiseau.—Pure distilled water to which are added 20 c.c. of Fehling's test per litre, decolourises this liquid after boiling for a few minutes. No decolouration is observed under the same circumstances if a very small quantity of a calcareous salt, *e.g.*, chloride of calcium, be previously added. This is an important precaution in the determination of small quantities of non-crystallisable sugar by Barreswill's method. Conversely, to ascertain the purity of distilled water, 50 c.c. may be boiled with 1 c.c. of Fehling's test.

Stony Concretion.—T. L. Phipson.—This calculus consists of xanthic oxide, uric acid, oxalate of lime, and phosphate of lime.

Bulletin de la Societe Chimique de Paris, Nos. 8 and 9, November 5, 1874.

Relations which Exist Between the Atomic Formulæ of Organic Bodies and the Rotatory Power of their Solutions.—J. A. Le Bel.—The author lays down the following general principle:—Let us consider a molecule of a chemical compound having the formula MA_4. M is a simple or complex radical combined to four monatomic atoms A, capable of being replaced by substitution. Let us replace three of them by monatomic radicals, simple or compound, differing among themselves and not identical with M. The body obtained will be dissymetric. In fact the totality of the radicals R, R', R'', and A, assimilated at material points, differing among themselves forms a structure not capable of being superimposed on its image, and the residue M cannot re-establish symmetry. Then, in general, if a body is derived from our primitive type, MA_4, by substituting for A_3 three distinct atoms or radical, its molecule will be dissymmetrical, and it will have rotatory power. (Second general principle.)—If in our fundamental type we substitute only two radicals, R and R', there may be symmetry or dissymmetry according to the constitution of the type-molecule, MA_4. If this molecule has a symmetrical plan, without regarding the two atoms which have been replaced by R and K, this plan will remain symmetrical after the substitution, and the body obtained will be optically inactive.

Swedish Correspondence, September 25, 1874.—M. P. T. Clève.—M. N. O. Holst has studied certain double cyanides of platinum. Thalen has published in the *Transactions of the Academy of Sciences of Stockholm* vol. xii., No. 4, a detailed work on the spectra of yttrium, erbium, didymium, and lanthanum. A. Atterberg has investigated boracic acid and certain borates. Olof Hammarsten has examined the coagulation of milk, proving that milk-sugar has no influence on the coagulation of milk by rennet. He throws down milk with chloride of sodium, re-dissolves the precipitate in water, and separates the butter by agitation; precipitates the casein a second time with chloride of sodium, and re-dissolves in water. He thus obtains a solution of casein free from sugar of milk, and which coagulates with rennet like milk. This coagulation cannot be due to lactic acid, and must be owing to a ferment in the rennet. The solution of the pure ferment does not yield the xantho-proteic reaction. It is not precipitated by nitric acid, alcohol, iodine, tannic acid, and neutral acetate of lead, but by the subacetate. Ebullition destroys its activity without coagulation. This ferment is soluble in water, glycerin, and saline solutions. Its solutions do not pass through membranes by diffusion. Alcohol destroys the ferment in course of time. The membrane of the stomach of all animals contains a soluble matter, which is not the rennet ferment, but which is converted into it by lactic or hydrochloric acid. The author has found that the membrane of the stomach, besides pepsine and this body, contains a third ferment which converts milk-sugar into lactic acid. M. Haldor Topsoe has described the crystalline forms of the platino-cyanides of didymium, cerium, lanthanum, erbium, yttrium, and thorium; the chloro-platinates of cerium; the double salts formed by mercurous chloride with the sulpho-cyanides of lanthanum, cerium, yttrium, erbium, didymium, and calcium; the hyposulphate of didymium; the sulphate of lanthanum; the seleniates of yttrium, erbium, didymium, and thorium; and other salts of the same group of metals. Otto Petterson has produced a memoir on the molecular volumes of certain series of isomorphous salts.

Correspondence from St. Petersburg, September 1 to 12, 1874.—M. W. Louguinine.—In the sixth fascicule of the *Journal of the Russian Chemical Society* M. Potylitzine gives a preliminary communication on the reciprocal displacement of the haloids. M. Gazarine makes known the preliminary results of a study of the isomers, C_2H_4BrI. MM. Popoff and N. Ley communicate the results of their researches on the oxidation of the oxacids of the fatty series. M. Prutz gives an analysis of the waters of Lake Aral, which resemble in composition those of the Caspian. M. Mendeleef describes a pump which he has constructed without taps or valves, and requiring very little mercury. It is founded on the vacuum produced by the descending movement of a vessel containing mercury. M. Goldstein communicates the results of his investigations on the oxidation of volatile nitro-phenol by the permanganate of potash. M. A. P. Dianine contributes a memoir on the products of the oxidation of the naphthols by means of perchloride of iron. M. P. Goloubeeff has investigated dinitrazo-benzoic acid; and M. N. Tawildaroff has been engaged with the combination of bromide of acetyl with aldehyd.

Moniteur Scientifique, du Dr. Quesneville, November, 1874.

Applications of Indigo in Dyeing and Printing.—M. A. Schultz.—A valuable practical paper, collating the methods used in some of the first dye and print works, both on the Continent and in this country. If possible it will be inserted in full.

Conditions of the Formation of Octahedral Borax.—M. D. Gernez.—This paper has been noticed elsewhere.

New Class of Explosive Matters.—Dr. Hermann Sprengel.—The author proposes a variety of explosive mixtures, such as nitro-benzine with nitric acid, a com-

pound which he considers more powerful than gun-cotton, or dynamite.

Natural Philosophy in England and in France.—J. M. Guardia.—A comparison of the state of science in England and in France, in which the author awards the palm of superiority to our country. The immediate occasion of his remarks is the Belfast speech of Dr. Tyndall, which he eulogises with great fervour. The following passage is not without interest:—"We have an official science, an officialr eligion, an official instruction; in other terms, a science, a religion, an instruction which are those of the majority. Add to these the armed forces and the magistracy, and you have the five classes of state (compare the five classes of the Institute of France) forming the formidable body of the French mandarinate. Reflect a little, friend reader, on the profound combinations of this Chinese mechanism; on the conditions of existence of this quintuple hierarchy; on the indefinite effects of this Gallo-Roman organisation. Evoke the shades of the great Napoleon, of Cuvier the orthodox, of Guizot the infallible, and you will not fail to comprehend the etiology and rhe pathogenesis, as the physicians say, of this chronic malady which we will call alethophobia, or in French the fear of truth,—a malady whose chief symptom is hypocrisy."

Solubility of Phosphates.—M. Jules Joffre.—The author considered it important to make some researches on the action of carbonate of lime upon soluble phosphate, and upon the influence of various bodies in preserving the solubility of phosphates in presence of the carbonate of lime. In France it is generally admitted that the soluble phosphate of all manures is immediately rendered insoluble under the influence of the carbonate of lime found in arable soils. From the author's experiments it appears that these views require to be considerably modified when certain substances are present. The acid phosphate of lime ($CaO,PO_5,2HO$) brought in contact with carbonate of lime in excess and with much water loses its solubility. But this reaction is not instantaneous; a certain amount of time is required and a small portion of the phosphate remains for a long time soluble. The same phenomena occur when, instead of pure acid phosphate of lime, we take a superphosphate containing mineral matters only. But if certain substances are added the result may be very different. The author placed 0·11 grm. of phosphoric acid, in the state of acid phosphate, in contact with 4 to 5 grms. of carbonate of lime, and left them for some days. In these conditions, and if no other substance is added, there remained, after the lapse of a few days, only 0·014 grm. of soluble phosphoric acid, or 21·8 per cent. On adding oxalate of lime there remained, after an equal time, 0·043 soluble, or 39·1 per cent. On adding sulphate of ammonia there remained 30·9 per cent; and on adding oxalate of ammonia there remained 68·2 per cent. A mixture of oxalate of lime and sulphate of ammonia acted like oxalate of ammonia. The author finds also that phospho-guanos, *i.e.*, guano rendered soluble by the addition of sulphuric acid, preserve their solubility much better than super-phosphates, owing doubtless to the organic matters, and especially to the oxalic acid which guano contains.

MISCELLANEOUS.

Exhibition of Appliances for the Economy of Labour, 1875.—The Council of the Society for the Promotion of Scientific Industry, the head-quarters of which are at Manchester, has decided to give gold, silver, and bronze medals for excellence and novelty in the various classes of exhibits at the Exhibition of Implements, Machines, and Appliances for the Economising of Labour, which is to take place in Manchester in 1875. The arrangements for the Exhibition are progressing satisfactorily, and space has been secured by many high-class engineering and other firms.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved process for treating madder for obtaining and separating alizarin and purpurin therefrom. Hector Auguste Dufrené, Rue de la Fidélité, Paris. (A communication from Jules Pernod, Avignon, France.) March 27, 1874.—No. 1074. Madder, flowers of madder, garancin, or other derivative from madder reduced to powder, is treated with a solution of sulphate of alumina, and, after boiling and filtering, sulphuric acid is added to the liquid which precipitates the purpurin. The ligneous residue is treated with sulphuric acid, water is added, and the temperature raised to about 212° F. The mass is then washed over a filter.

Improvements in the treatment of waste or refuse animal or nitrogenous matters, for the purpose of producing fertilising substances or artificial manures. William Crookes, F.R.S., Mornington Road, Regent's Park, Middlesex. April 2, 1874.—No. 1152. In carrying out my invention I take fish, flesh, or other putrescible animal matters, and after cutting up or reducing the substance to a divided state, I steep it if necessary in any convenient liquid compound possessing antiseptic, deodorising, or disinfecting properties; or I sprinkle such liquid over the solid matters. I then place the mass in a hydro-extractor, or other suitable apparatus, for the purpose of driving off and separating the liquid matters from the solid.

A new or improved anti-fouling composition or paint. Elias Jones, paint manufacturer, Swansea, Glamorgan, and Andrew Howatson, mechanical engineer, Cronberry, Auchinlech, Ayr, N.B. April 4, 1874.—No. 1173. The novelty of the invention consists in producing an anti-fouling composition or paint by mixing together dissolved American resin and melted mutton suet with oxide of zinc, prepared chalk, carbonate of lead, and arsenic in given proportions; and then grinding the whole together, and applying it to the surface to be coated whilst hot.

Improvements in thermo-electric piles. Charles Clamond, engineer, Boulevard de Strasbourg, Paris. April 6, 1874.—No. 1199. This invention relates to—First. A method of sealing or of separating thermo-electric negative plates. Second. The formation of thermo-electric bars in a mould previously heated almost to the point of fusion of the thermo-electric substance. Third. An arrangement for heating by gas according to the construction of the apparatus to permit of the employment of a cylindrical Bunsen or atmospheric burner, with a supply of additional air from the outside. Fourth. Building up and binding the pile proper between two ring plates united by bars and rods. Fifth. A special arrangement for heating by coke by the aid of a radiating cylinder of a movable bar, and of a feed receiver.

An improved method of treating tobacco to free it from nicotine and ammonia. Henry Woodcroft Hammond, civil engineer, Southampton Buildings, Chancery Lane, London. (A communication from Charles Augustus Weigold, Reudnitz, Saxony.) April 9, 1874.—No. 1227. This invention relates to an improved process of preparing a chemical conserve tobacco free from nicotine and ammonia; and consists in allowing steam to pass through a hermetically closed vessel to soften the tobacco, when by means of Bequereux air rarefaction apparatus connected with said vessel, all the nicotine, ammonia, and air are extracted from the tobacco and the vessel containing it. To replace the deleterious properties of the nicotine and ammonia, and give to the tobacco an agreeable aroma, the prepared and combined extracts of either of the following ingredients or receipts are added to each cwt. of tobacco, viz.:—First. 8 litres of water, 2 litres of beer, ¼lb. of green tea, ¼lb. ground plum kernels, 10 grms. of fine honey, 5 grms. of rose leaves, 1 grm. of vanille, 6 grms of peppermint, and 1 lb. of juniper berries. Or, secondly, 10 litres of water, 2 grms. of cardamon, 3 grms. of ginger, 2 grms. of lavender flowers, 2 grms. of galangel, 2 grms. of reseda oil, 25 grms. of currants, 50 grms. of plum kernels, 1 lb. of juniper berries. Or, thirdly, 10 litres of water, 2 grms. of cardamon, 3 grms. of ginger, 2 grms. of lavender flowers, 2 grms. of galangel, 2 grms. of reseda oil, 25 grms. of currants, 50 grms. of plum kernals, 1 lb. of juniper berries. These prepared ingredients are allowed to simmer with the tobacco for three hours, when the tobacco is taken out of the vessel and dried, and made ready for use.

MEETINGS FOR THE WEEK.

Monday, Jan. 4th.—Medical, 8.
— London Institution, 5.

Tuesday, 5th.—Royal Institution, 3. Professor Gladstone, "On the Voltaic Battery." The History of the Battery in its Various Forms. (Juvenile Lecture.
— Zoological, 8½.

Wednesday, 6th.—Microscopical, 8.

Thursday, 7th.—Royal Institution, 3. Professor Gladstone, "On the Voltaic Battery." Electrotyping &c. (Juvenile Lecture.)
— Royal Society, 8½.
— London Institution, 7.

Saturday, 9th.—Royal Institution, 3. Professor Gladstone, "On the Voltaic Battery." The Electric Telegraph (Juvenile Lecture.)

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THE CHEMICAL NEWS.

VOL. XXXI. No. 789.

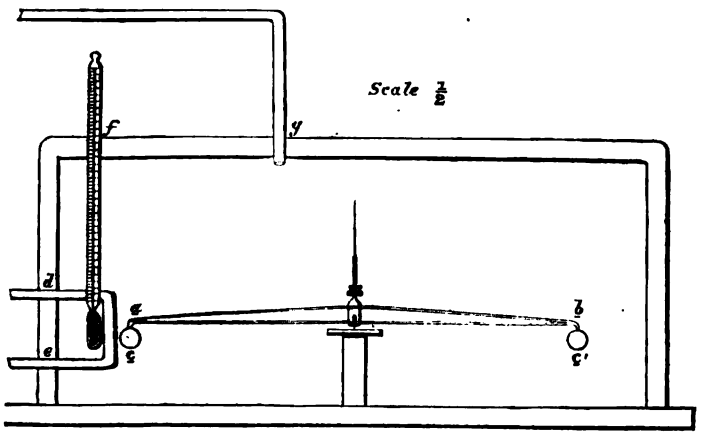
ON ATTRACTION AND REPULSION RESULTING FROM RADIATION.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from page 2.)

18. A LIGHT beam (*a b*, Fig. 1) was made of two pieces of fine flattened brass wire 120 millims. long, 5 millims. apart at the point of suspension, and joined together at each end. A pair of very fine needle-points, one on each side of the beam, represented knife-edges, and worked on glass plates cemented horizontally to upright pillars. The centre of gravity could be altered by a screw, and a pointer

FIG. 1.



projecting upwards enabled me to see a movement of the beam. A brass ball (*c*, *c'*) 6 millims. diameter, was soldered to each end of the beam. The balance was adjusted so that it made one oscillation in about five seconds.

19. The case consisted of a rectangular box of brass, 10 m.m. thick, the front of which was replaced by plate glass. At one end two holes were drilled (*d*, *e*) about 20 mm. apart, and a curved piece of glass tube was cemented in, so that both ends were outside. At the top a hole (*f*) was drilled to receive a thermometer, and another (*g*) to receive the tube attaching the instrument to the Sprengel pump. By sending a current of hot water through the bent glass tube, heat could be communicated to one of the brass balls, and the movement, if any, of the beam could be seen by a micrometer in front. Many experiments were tried with this apparatus, and the result appeared to be that warming the ball caused it to sink (49). This action might, however, be due to the expansion of the brass beam by heat; so to obviate this source of error, I sought for a material wherewith to make a beam which should be as little affected as possible in this manner.

20. A stick of fine-grained charcoal was worked up into the shape of a beam, and fitted at each end and in the centre with appropriate metallic collars for the needle-points and brass balls. To get rid of absorbed gases, which experience showed were evolved unequally in a vacuum, and thereby threw the beam out of adjustment, it was first heated strongly in an exhausted tube, and then soaked in an alcoholic solution of shellac. When quite dry, the charcoal was heated till the shellac fused. After much difficulty the beam was adjusted, and being enclosed in the brass case described above, exhaustion was effected. With this charcoal beam I also found that heat generally caused the brass ball to sink (49).

21. These results were opposed to what I had before noticed, but many anomalies were observed (49). Thus the diminution of gravity did not appear to vary as the rarefaction increased; and the position of the hot body, in relation to the brass ball, seemed to have considerable influence on the direction and amount of movement. It was also difficult to make the brass case, with its numerous joints, sufficiently tight to hold a Sprengel vacuum,* even by painting it over with gold-size when partially exhausted, and I therefore decided to form the beam of some other material.

22. A mica beam was at first tried, but it was found to be liable to split across. Magnesium possesses the advantages of lightness and rigidity, but was inapplicable, owing to its expanding by heat. A gridiron beam of zinc and iron, or of zinc and glass, and a beam formed of two reversed thermometers, their bulbs forming the gravitating masses, were thought of, so as to have self-compensation for changes of temperature; but after a few experiments the weight of such beams was found to be an insuperable objection, even had the difficulties of adjustment been overcome. Altogether glass seemed to offer most advantages, as being sufficiently rigid, whilst its low conducting-power for heat rendered it little liable to introduce errors from expansion.

A straight glass beam was drawn from a piece of rectangular glass tube, and it was fitted with needle-point centres and brass balls at each end, similar to the plan adopted with the brass and charcoal beams. This was fitted in the small brass case, and many experiments were tried with it. The results were still anomalous, the apparent action of heat being sometimes in one direction and sometimes in another (49).

Greater delicacy was still required, and the brass balls at the end of the beam were accordingly replaced with magnesium balls; and instead of enclosing the balance in the brass case, I sealed it up, after exhaustion, in a glass tube. With this a large number of experiments were tried; but as the subsequent results, after I had discovered one of the laws governing the phenomena, were much more satisfactory, I forbear from occupying space in describing these preliminary experiments.

23. Afterwards I experimented successively with a glass beam having no special weight at the ends, and with the same beam with terminal knobs of glass fused on; this appeared to increase the delicacy somewhat, but the weight was still too great to allow of accurate results being obtained; and I finally adopted straw as the materiai for the beam, varying the gravitating masses at the end as experience dictated. Straw possesses many advantages: it is exceedingly light, yet rigid; it dries easily, and evolves

* From the *Philosophical Transactions o the Royal Society of London*, vol. clxiv., par 2.

* As I shall have to speak of various kinds of vacua, it will be best to name them distinctively to avoid periphrasis. I shall call the best vacuum which my air-pump will give an *air-pump vacuum*—this is one or two millimetres below the barometer. The ordinary vacuum produced by the Sprengel pump I shall call a *Sprengel vacuum*—in this the gauge is appreciably level with the barometer. A so-called "perfect" vacuum, produced by potash and carbonic acid, as subsequently described, or by similar means, I shall call a *chemical vacuum*, I object to the term *perfect*, as applied to any vacuum at present known, as I believe that where force can travel we are not justified in assuming the absence of matter—imponderable it may be, and unaffected by ordinary forms of force—but none the less *matter*.

no vapour in a vacuum; moreover, it is not likely to introduce errors by altering in shape under the influence of the moderate degrees of temperature to which it is subjected in these experiments.

Fig. 2.

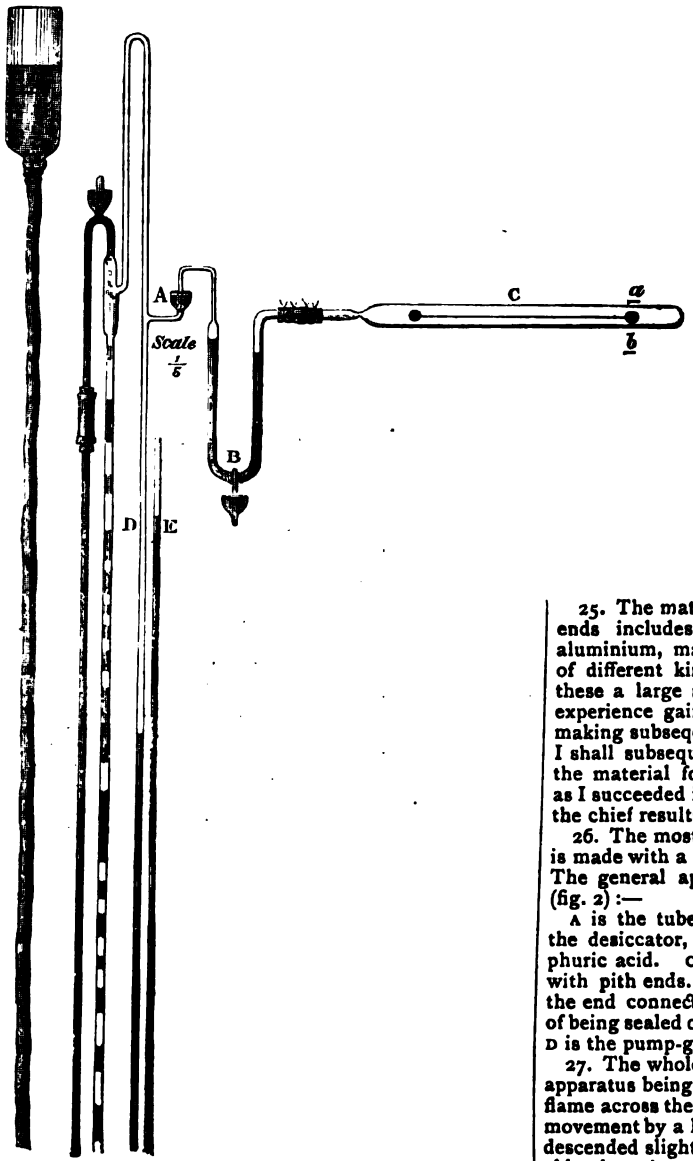
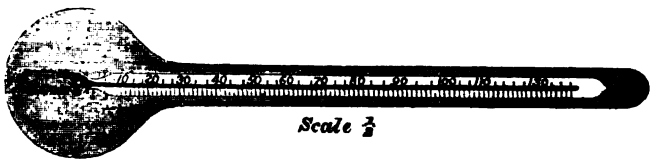


Fig. 3.



24. The method of supporting the straw beam in the centre, so as to secure the maximum sensitiveness without the liability to get out of order, was difficult at first. After trying suspension by fibres of cocoon-silk from a glass frame, suspension on a fine glass axis resting on thin glass rods, and many other devices, I finally adopted the following mode of support:—

The pointed half of a small sharp needle is broken off about half a millimetre shorter than the internal diameter of the glass tube; the blunt end is then ground very sharp on Arkansas stone. The straw, about seven inches long, having its gravitated masses at the ends, is then balanced on a knife-edge so as to let it roll over to a stable position and to find its centre; and the needle is then run through it at right angles, at such a distance above the horizontal centre of the straw that the centre of gravity of the whole system is a little below the centre of suspension. The beam being slipped into the glass tube (sealed at one end), the needle is supported very delicately against the sides of the glass by its points, and with the least possible amount of friction. It is best now to exhaust temporarily, heating the straw by passing a spirit-flame along the tube, so as to drive off moisture. If, as is almost certain to be the case, one end becomes heavier than the other, equilibrium can be restored, without much difficulty, by holding the spirit-flame for a few seconds under the heavier end, so as to slightly char the straw or other material. When in good adjustment and sufficiently sensitive the balance is ready for experiment.

25. The material with which I form the masses at the ends includes platinum, brass, silver, lead, bismuth, aluminium, magnesium, glass, selenium, ivory, charcoal of different kinds, straw, cork, and pith. With each of these a large series of experiments were tried, and the experience gained with each was turned to account in making subseqent apparatus.* Certain differences, which I shall subsequently allude to, were noticed according to the material forming the gravitating mass; but as soon as I succeeded in obtained the requisite degree of delicacy, the chief results were as decided as they were unexpected.

26. The most delicate apparatus for general experiment is made with a straw beam having pith masses at the end. The general apparatus is shown in the annexed figure (fig. 2):—

A is the tube belonging to the Sprengel pump.† B is the desiccator, full of glass beads moistened with sulphuric acid. C is the tube containing the straw balance with pith ends. It is drawn out to a contracted neck at the end connected with the pump, so as to readily admit of being sealed off if desired at any stage of the exhaustion. D is the pump-gauge, and E is the barometer.

27. The whole being fitted up as here shown, and the apparatus being full of air to begin with, I passed a spirit-flame across the lower part of the tube at *b*, observing the movement by a low-power micrometer; the pith ball (*a b*) descended slightly, and then immediately rose to considerably above its original position. It seemed as if the true action of the heat was one of attraction, instantly overcome by ascending currents of air. A hot metal or glass rod and a tube of hot water applied beneath the pith ball at *b* produced the same effect as the flame; when ap-

* It is only fair to acknowledge here the assistance which I have received during the progress of these experiments from my young friend and pupil, Mr. Charles H. Gimingham. Without his skill with the blow-pipe and delicacy of manipulation with complicated apparatus, it would have been difficult for me to have carried out this investigation during the limited time I am able to devote to original research.

† For a full description of this pump, with diagrams, see *Phil. Trans.*, 1873, vol. clxiii. p. 295.

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plied above at *a*, they produced a slight rising of the ball. The same effects take place when the hot body is applied to the other end of the balanced beam. In these cases air-currents are sufficient to explain the rising of the ball under the influence of heat.

28. In order to apply the heat in a more regular manner, a thermometer was inserted in a glass tube, having at its extremity a glass bulb about 1½ inches diameter; it was filled with water and sealed up (see fig. 3). This was arranged on a revolving stand, so that by means of a cord I could bring it to the desired position without moving the eye from the micrometer. The water was kept heated to 70° C., the temperature of the laboratory being about 15° C.

29. The barometer being at 767 millims. and the gauge at zero, the hot bulb was placed beneath the pith ball at *b*. The ball rose rapidly. As soon as equilibrium was restored I placed the hot-water bulb above the pith ball at *a*, when it rose again, more slowly, however, than when the heat was applied beneath it.

30. The pump was again set to work; and when the gauge was 147 millims. below the barometer, the experiment was tried again; a similar result, only more feeble, was obtained. The exhaustion was continued, stopping the pump from time to time to observe the effect of heat, when it was seen that the effect of the hot body regularly diminished as the rarefaction increased, until, when the gauge was about 12 millims. below the barometer, the action of the hot body was scarcely noticeable. At 10 millims. below it was still less; whilst when there was only a difference of 7 millims. between the barometer and the gauge, neither the hot-water bulb, the hot rod, nor the spirit-flame caused the ball to move in an appreciable degree.

The inference was almost irresistible that the rising of the pith was only due to currents of air, and that at this near approach to a vacuum the residual air was too highly rarefied to have power in its rising to overcome the inertia of the straw beam and the pith balls. A more delicate instrument would doubtless show traces of movement at a still nearer approach to a vacuum; but it seemed evident that when the last trace of air had been removed from the tube surrounding the balance—when the balance was suspended in empty space only—the pith ball would remain motionless, wherever the hot body were applied to it.

31. I continued exhausting. On next applying heat, the result showed that I was far from having discovered the law governing these phenomena; the pith ball rose steadily, and without that hesitation which had been observed at lower rarefactions. With the gauge 3 millims. below the barometer, the ascension of the pith when a hot body was placed beneath it was equal to what it had been in air of ordinary density; whilst with the gauge and barometer level its upward movements were not only sharper than they had been in air, but they took place under the influence of far less heat—the finger, for example, instantly repelling the ball to its fullest extent.

To verify these unexpected results, air was gradually let into the apparatus, and observations were taken as the gauge sank. The same effects were produced in inverse order, the point of neutrality being when the gauge was about 7 millims. below a vacuum.

(To be continued.)

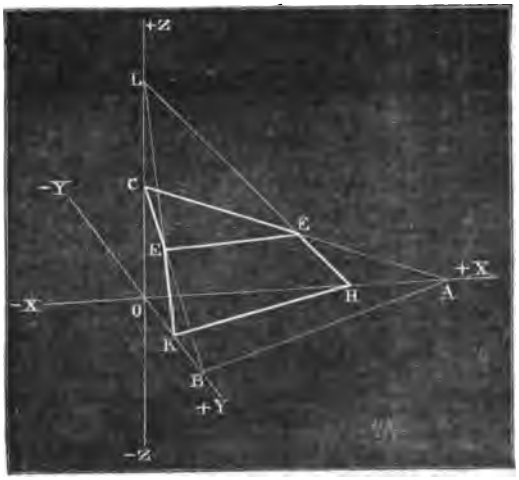
Coal in Patagonia.—G. De Saugainnecourt has discovered extensive deposits of coal on the coast of Patagonia, (lat. 53° 9' 40" north (?); long. 73° 13' 46" west). They extend apparently over 975 hectares and consist of three beds, the highest of which is five metres in thickness. The coal appears to belong to the class of lignites.

LECTURES ON THE MORPHOLOGY OF CRYSTALS
AT THE
CHEMICAL SOCIETY.

By NEVIL STORY MASKELYNE, M.A., F.R.S., &c.

LECTURE II.

PASSING from the case of two axes lying in a plane Mr. Maskelyne proceeded to consider that of three axes in space. They were taken as before to be perpendicular to each other, the point O or *origin* in which they intersected being taken somewhere in the interior of the crystal. The three axes were supposed parallel to three edges in which three faces of the crystal would intersect. A position to the right of O parallel to the axis of X, or above O parallel to the axis of Z, or forward from O parallel to the axis of Y, was in each case considered as positive. Positions on the opposite sides of these to O were considered as negative. A B C and H K L were now supposed to be two faces of the crystal, and they were both supposed to lie in that octant which was included by the three positive directions of the axes. The edge in which they would intersect



would be the line E E. The portions of the axes intercepted by the plane A B C (the intercepts of this plane) are O A, O B, O C; those of the plane H K L are O H, O K, O L.

They will be larger in a larger crystal, smaller in a minuter one, *i.e.* according to the distance of the face from the centre; but their *ratios will always be the same*. Let these ratios be

$$O A : O B : O C = a : b : c$$

and

$$O H : O K : O L = \frac{1}{h}a : \frac{1}{k}b : \frac{1}{l}c$$

Whatever fractions may actually represent the ratios of O H to O A, O K to O B, and O L to O C, we of course can always reduce these to such fractions of *a*, *b*, and *c* as have unity for their numerator.

The fundamental law of crystallography declares the ratio of these magnitudes O H : O K : O L to be always capable of being represented by such fractional ratios

$$\frac{1}{h}a : \frac{1}{k}b : \frac{1}{l}c$$

as present h, k, and l in the form of simple whole numbers, generally less than 7.

The magnitudes *a b c* are called the *parameters* of the crystal; *h k l* are the *indices* of the face to which they refer. In the figure the face H K L meets

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the axis X with an intercept O H $= \frac{2}{3}a$

the axis Y ,, ,, O K $= \frac{1}{2}b$

the axis Z ,, ,, O L $= 2c$

and $\frac{2}{3}a : \frac{1}{2}b : 2c = \frac{a}{3} : \frac{b}{4} : \frac{c}{1}$.

If the face H K L be denoted by the *symbol* $(h\,k\,l)$, in the case in the figure this symbol becomes (341), *the order of the indices always being taken* in that fixed for the axes to which they refer, namely, *in the order* X Y Z.

It is evident, then, that on any crystal when once the axial system is determined on, *i.e.*, when the axes and the face fixing the parameters have been chosen, all that is needed uo determine a face is to know its indices.

The indices of the parametral face A B C are evidently (111). Where a face is parallel to an axis, its index is for that axis zero. (340) is the symbol of a plane which intercepts $\frac{a}{3}\,\frac{b}{4}\,\frac{c}{0}$; where $\frac{c}{0}$ represents an indefinitely great magnitude, so that the face H K L would not cut the axis Z as in the figure in a point L, but at an infinite distance, *i.e.*, is parallel to O Z.

Had either of the points H, K, or L lain on the other side of the centre O to that on which it is in the figure, it would be indicated by a minus sign, and *such a sign is placed over the corresponding index.* Thus $(3\bar{4}1)$ would be the symbol of a face for which the H and L points would lie to the left of O on O X and below O on O Z; K remaining as in the figure.

The faces whose edges are parallel to the selected crystallographic axes will have for their symbols (100) or $(\bar{1}00)$ for a face parallel to a plane Y Z containing the axes Y and Z; (010) or $(0\bar{1}0)$ for that of the plane Z X, and (001) or $(00\bar{1})$ for that of the plane X Y.

The ratios $\frac{1}{h} : \frac{1}{k} : \frac{1}{l}$ might equally easily and with equal truth be thrown into the form of whole numbers; the plane H K L in the figure having then the intercepts $4a : 3b : 12c$. The symbols obtained by using the fractional indices are, however, more simple, and admit in their use of more elegant mathematical expressions and methods of calculation.

The meaning of the term coordinates in connection with the three axes was now explained by the lecturer, who further stated that the planes designated by the symbols $(h\,k\,l)$ and $(p\,q\,r)$ may be represented severally by the expressions—

$$h\frac{x}{a} + k\frac{y}{b} + l\frac{z}{c} = 0$$

$$p\frac{x}{a} + q\frac{y}{b} + r\frac{z}{c} = 0$$

which are, in fact, expressive of the relations between the parameters $a\,b\,c$, the magnitudes $h\,k\,l$ (or $p\,q\,r$), involving the ratios of the indices, and the coordinates $x\,y\,z$ for any point in the plane; the planes being supposed to be moved parallel to themselves till they passed through the origin, in which case, obviously, their edge must pass through that point. This edge, then, in which these planes intersect would be a line, for each point in which the above two expressions have the same meaning, so that, by first getting rid of x by elimination from the two equations, we get the relation between y and z, the expression becoming—

$$(h\,q - k\,p)\frac{y}{b} = (l\,p - h\,r)\frac{z}{c};$$

and, secondly, by eliminating y, the relation between x and z is seen to be—

$$(h\,q - k\,p)\frac{x}{a} = (l\,q - k\,r)\frac{z}{c};$$

so that—

$$\frac{z}{c} \cdot \frac{1}{hq - kp} = \frac{y}{b} \cdot \frac{1}{lp - hr} = \frac{x}{a} \cdot \frac{1}{lq - kr},$$

which may be written—

$$\frac{x}{u\,a} = \frac{y}{v\,b} = \frac{z}{w\,c}$$

where—

$$w = lq - kr,\ v = lp - hr,\ w = hq - kp.$$

In the example previously considered, namely, in the two planes (111) and (341), the expression becomes—

$$\frac{x}{-3\,a} = \frac{y}{2\,b} = \frac{z}{c},$$

so that the u, v, and w become in this case $[-321]$.

It was shown by a representation of three perpendicular axes, and of the co-ordinates strained in coloured threads upon it, that the edge in this case represented by its direction the diagonal of a parallelepiped, the sides of which were in the proportionate lengths of $-3\,a$ on the axis of X, $2\,b$ on the axis of Y, and c on the axis of Z.

On a crystal for every edge formed by a pair of planes there must be an indefinite number of other edges parallel to the edge in question, and it is clear that a plane perpendicular to one of these edges would be perpendicular to them all, and would be perpendicular to the planes to the intersections of which they are due. Such a series of planes forms a zone, and if those planes be each moved parallel to itself till it passes through the origin, all the planes of the zone would intersect in a single line, like the consecutive pages of an open book; that line is called the zone axis, and the plane perpendicular to it is called the zone plane. The expressions $[u\,v\,w]$ or, as in the example taken $[\bar{3}21]$ is placed within square braces to indicate that it represents a zone axis, and therefore also a zone. Evidently this zone axis would be identically represented by the edge in which any two planes of the zone would intersect; but it will be found that the actual numerical values thus obtained for the indices in the symbols of one edge in the zone differ in general by a common factor from those in the symbol of a different edge in it.

A ready method of obtaining the symbol of a zone from those of any two of its faces was then illustrated.

The latter symbols being written, each are repeated in two lines, and the indices of the new symbol being obtained by finding the difference of the products taken diagonally—first, of the second and third indices on the two lines; next, of the third and fourth; and, finally, of the fourth and fifth indices on each line.

The next relation illustrated was that connecting the indices of any other plane in the zone with those of the two taken to give the symbol of the zone, —*viz.*

$$e\,u + f\,v + g\,w = 0,$$

where $u\,v\,w$ are the indices of the zone $[h\,k\,l, p\,q\,r]$ as obtained by the above method from the symbols for the faces $(h\,k\,l)$ $(p\,q\,r)$.

A similar expression to that for a zone as derived from two of its planes may be got for a face common to two zones.

Thus, $e\,u + f\,v + g\,w = 0$,

and $e\,u' + f\,v' + g\,w' = 0$,

represent the relation of the face $e\,f\,g$ to the symbols of each of two zones $[u\,v\,w]$ and $[u'\,v'\,w']$, *i.e.*, $h\,k\,l\ p\,q\,v$ and $[h'\,k'\,l'\ p'\,q'\,v']$.

Then, $e = v\,w' = w\,v'$

$f = w\,u' - u\,w'$

$g = u\,v' - v\,u'$.

It is clear that these values for $e\,f\,g$ must be rational, so that any two zones must be tautohedral in a plane satisfying the condition of rationality which is the condition

necessary for such a plane being a possible face of the crystal. Examples of these laws were given in the case of the zone [111, 341] or [$3\bar{2}1$], which also contains the faces (214) and ($01\bar{2}$), the edges for which gave symbols differing from each other by common factors, such as -1, 3, and 5.

So also this zone [$\bar{3}21$], and a zone [110, 001], *i.e.*, [$1\bar{1}0$], have in common the face (111) and the face ($\bar{1}\bar{1}\bar{1}$).

ANALYSIS OF MOFFAT AND HERTFELL SPAS COLLECTED ON THE 5TH AND 12TH OCTOBER, 1874.

By W. JOHNSTONE, Edinburgh.

Moffat Spa.

This valuable sulphurous spring, to which Moffat owes its celebrity, was discovered in 1633, and the discoverer is said to have been a daughter of Bishop Whiteford. There are two springs, the upper and the lower, but being only about a yard or so distant, they are regarded as the same well. The springs rush from a cavity of a rock on the brink of a linn, down which rushes a mountain stream. The spring is enclosed by a small square winstone building, the water being collected in a hollow hewn out in the rock, from which it is drawn off by means of a pipe, and handed to the drinkers, containing the following constituents—

Specific gravity at 60° F. 1001·068
Temperature 49·5° F.
Temperature of air 64·0° F.

Sodium chloride	0·8524
Sodium sulphydrate	0·0078
Calcium chloride	0·1243
Calcium sulphate	0·0125
Calcium carbonate	0·0940
Magnesic chloride	0·0581
Magnesic carbonate	0·0402
Potassic chloride	0·0616
Ferrous carbonate	0·0247
Silica	0·0180
	1·3936
Total residue in one litre dried at 356° F.	1·3874
Volatile and organic matter	0·1150
Total solid residue in one litre	1·5024

Iodine, manganese, and lithia, in minute traces.

Gases dissolved in one litre	34·508 c.c.
Hydrogen sulphide	5·325
Nitrogen	25·644
Carbonic dioxide	2·539
Oxygen	0·999
	34·507

Hertfell Spa.

This also valuable aluminous sulphate chalybeate, springs from the bottom of a deep rocky ravine on the side of the mountain of the same name.

It is distant five miles from Moffat, and there being no regular road part of the way, the generality of the drinkers of it have to obtain their supply from Mr. T. Hetherington, druggist, in the town.

Hertfell Spa, which has a strong astringent taste, is most powerful after a fall of rain, and in the greatest perfection when wet is preceded by continued dry weather. It may be preserved for a lengthened period (without the ceremony of hermetical sealing) in a state of purity and efficiency. The spa was discovered by an eccentric individual, named John Williamson, in 1748, and is 1155 feet above the level of the sea, or 808 feet above the level of Moffat High Street.

Specific gravity 1000·386
Temperature 49° F.
Temperature of air 56° F.

Ferrous sulphate	0·2109
Aluminic sulphate	0·1970
Sodium chloride	0·0050
Sodium sulphate	0·0048
Calcium sulphate	0·0352
Calcium carbonate	0·0280
Magnesic sulphate	0·0233
Magnesic carbonate	0·0121
Ferrous carbonate	0·0240
Silica	0·0050
	0·5453
Total residue in one litre dried at 356° F.	0·5321
Volatile and organic matter	0·0022
Total residue in one litre	0·5343

Contains traces of manganese and potash.

Gaseous constituents in one litre	30·854 c.c.
Carbonic dioxide	6·734
Oxygen	6·062
Nitrogen	18·057
	30·853

ON THE DISTILLATION OF AMMONIA IN PRESENCE OF SULPHOCYANIDES.

By A. ESILMAN.

The estimation of ammonia by distilling with caustic alkali a known weight of any ammoniacal salt into standard dilute sulphuric acid, and determination of the acid thus neutralised, is one of those processes which are exact enough to satisfy the requirements of the scientific chemist, and capable of such rapidity of execution as to make them invaluable in the hands of the manufacturing chemist. With carefully standardised test acid and alkali solutions the results need not vary more than one or two-tenths per cent. Having had occasion within the last two years to use this volumetric method daily in the examination of gas liquors, and sulphates of ammonia made from the washings of gas oxide of iron, my attention has several times been drawn to some little discrepancies cropping up in spite of the greatest care. In investigating the causes of these differences, the question arose,—does the sulphocyanide present in the sulphate of ammonia as well as in the gas liquor decompose during the distillation under the influence of the excess of alkali? Sulphocyanides submitted to dry distillation with slaked alkalies produce large quantities of ammonia, and it was possible that a similar reaction might take place, though more slowly, at the boiling temperature. To test this point a solution of sulphate of ammonia containing four to five per cent of sulphocyanide was made and used for the following experiments, in which definite quantities were boiled for various lengths of time with different proportions in excess of the liberating alkali.

The following results were obtained:—

Using—	Per cent of Ammonia.
Caustic soda	23·87
"	24·19
Carbonate of soda	24·15
"	23·64
Lime	23·47
"	23·80
"	23·608
"	23·97

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These results were sufficiently contradictory to confirm my suspicions, and also to raise the doubt that only after the complete removal of the sulphocyanogen could the ammonia be distilled and correctly determined. Before attempting to settle this point I resolved to make sure that there was no defect in the distilling apparatus. This consisted of a twenty-ounce flask, generally filled half full, connected by glass and india-rubber tubing with two bottles, and so arranged that none of the boiling liquid in the flask would be sucked over during sudden condensation. Pure water coloured with delicate pink litmus solution was put into the bottles, and ammonia-free dilute caustic soda solution into the flask; the latter was then boiled into the former. After a few minutes ebullition there was a gradual change in the coloured liquid. It became purple, then blue, and there was thus seen to be manifestly something at fault. The small flask was replaced by a large one, into which the distilling liquid was poured, occupying about half an inch at the bottom; but on *slow* boiling the same result was obtained, and not only once, but a dozen times. The interposition of a bulbed tube containing broken glass between the flask and bottles made no difference, thus showing that the alkali could not have been carried over mechanically. The same results were also obtained when milk of lime was employed in place of caustic soda, and yet neither of these alkalies could be found in the distillate. The anomaly, however, was soon explained:—On substituting bent glass tubing in place of the glass and india-rubber found so convenient, and continuing the distillation, no alteration in the colour of the pink litmus solution was observed, even after long boiling, and a portion of the distillate subjected to Nessler's test gave no indications of ammonia. When the india-rubber tubing was used once more, the distillate gave a very decided colour to Nessler's solution.

Although I have not seen any published records of the absorbent powers of india-rubber tubing for ammonia, I can scarcely believe that it has so long escaped notice; and, considering its wide application, it may not be amiss in me to impress upon others the necessity of restricting its use to the utmost point consistent with flexibility in connecting apparatus. It is quite possible that the materials incorporated with the rubber during the manufacture, as gypsum for example, may be the cause of the disturbance; but this point I have not examined.

Having then altered my connecting tubes so as to employ a minimum of india-rubber, I made the following experiments to ascertain the extent of the decomposition of the sulphocyanogen during distillation with various alkalies. A solution of sulphate of ammonia containing 4 per cent of sulphocyanogen was used. The results are as follows:—

Liberating Alkali.	Per cent of Ammonia.
Caustic soda	21·261
„	21·672
„	21·354
Caustic lime	20·883
„	20·990
Caustic magnesia	20·998
„	20·873
After separation of the sulphocyanogen as sulphocyanide of copper, and distillation with caustic soda	20·908

Another sample of sulphate of ammonia of similar composition gave—

By distillation with soda .. .. 22·08 per cent
„ „ magnesia .. 21·33 „

These results are sufficiently conclusive to show that decomposition of sulphocyanogen does take place when caustic soda is employed in liberating the ammonia; that the extent of error thus introduced is very appreciable; and that it can be eliminated by using caustic lime or magnesia in place of soda. I prefer lime, as magnesia, from its great insolubility, is slow in its action.

Manchester, December 24, 1874.

NOTES ON THE FORMATION AND CONSTITUTION OF TORBANITE.

By WILLIAM SKEY.

In prosecuting experiments previously detailed, upon the evolution of heat caused by mixing dry clay with various liquids, I noticed such an increase of temperature in the case of petroleum that I suspected an absorption of a portion of the matters dissolved in this liquid had occurred, and so was led to investigate the matter further, when the following results were obtained:—

(1.) That our commercial kerosenes are nearly or quite decolorised by mixing them with dry clay, and our best native petroleums greatly modified.
(2.) That this process is very much quicker when the clay used has been dried at 100° or so C.
(3.) That in such a case the clay, if white, acquires a rose and afterwards a black colour, while its streak is light brown.
(4.) That torbanite has the same effect as clay.
(5.) That the coals I have examined, whether hydrous or anhydrous, do not appear to exercise any absorbent action upon the petroleum oils.
(6.) That the same is true of diatomaceous earth (dry), carbonate of lime, and gypsum, hydrous or anhydrous, also pumice-stone and pipe-clay (ignited).
(7.) That kerosene which has been completely decolorised by clay, when heated to 100° to 150° C. blackens clay, but has no such effect upon other porous substances, as gypsum, prepared silica, or the light oils of kerosene.
(8.) That clay is similarly affected by hot paraffin.
(9.) That clay can readily be charged with some of the constituents of petroleum, to such an extent as to have almost the consistence as well as the appearance of torbanite.

These results have, I believe, an important bearing upon our present theories as to the formation and constitution of the valuable mineral torbanite. As to the formation of this mineral, it plainly appears from them that clay strata will abstract the colouring matter of petroleum passing through them.

If this process is carried on to a small extent we have only a feebly bituminous clay, but if carried on till the clay is saturated, or nearly so, we have a mineral which I believe has exactly the constitution of torbanite.

During the formation of this mineral the petroleum passing through it would be purified to a greater or lesser extent.

From what has been already stated, I feel sure the absorption is not of a mechanical but of a chemical nature, and this brings me to the next point, that is, the true constitution of the mineral in question, torbanite or boghead coal.

As to its constitution, this mineral is associated with the amber group in our best mineralogical works, and the earthy matter is thrown out of the formula. Now this is within small limits uniform in amount in the case of all the samples of this mineral yet analysed, being from 19 to 26 per cent, and it is essentially silicate of alumina that is anhydrous clay.

I consider, therefore, the ash of this mineral is not an accidental element as it is now considered, but that it is an essential part of it,—that in fact torbanite is a combination of a bituminous kind of substance with clay, the water of the clay being either substituted by it or a bituminosilicate of alumina formed, which substance may have no affinity or but a very slight one for water.

I should state that the coloring matters of petroleum and kerosene are in general terms described as of a bituminous nature—but whether bitumen itself is actually or universally present has not yet been demonstrated. However, these colouring matters are certainly oxidised hydrocarbons, and so class with bitumen and the combustible part of torbanite.

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Being thus oxidised hydrocarbons they can hardly fail to be of an acidic nature, and so the statement as to their capability to chemically combine with clays as shown, is one which a consideration of the basic nature of clay will, I think, greatly predispose us to admit to be a correct one.

In conclusion, these results tend to indicate—

(1.) A cheap and expeditious method for purifying our coloured kerosenes, one in which there need hardly be any waste.

(2.) That by using pure clay useful pigments may perhaps be obtained in this manner.

(3.) That torbanite is *not coal* but a chemical combination of an acid hydrocarbon with silicate of alumina. In this assumption I accept for the present the popular opinion which maintains the ash of coal itself to be an *accidental* element.

(4.) That our present formula for torbanite requires amendment so as to include earthy matters.

I will only add that judging from the basic nature of alumina and the refusal of silica in any form to combine to a notable extent with any of the constituents of petroleum, it appears most likely it is the alumina of the earthy matters of torbanite to which the retention of its combustible part is due. This matter and the possibility or otherwise of substituting compounds of tin, iron, copper, &c., for that of alumina as absorbents of the substances named, is now engaging my attention, and so I trust to be able to give information upon these points at an early date.

THE PRIESTLEY CELEBRATION AT NORTHUMBERLAND, PENNSYLVANIA.*

The year just closed has witnessed a celebration unique in history. Two nations have simultaneously done honour to the memory of an illustrious chemist who, a century ago, discovered oxygen and thus opened a new era in science. In England, in the very town where his house had been sacked and burned, his books and manuscripts scattered to the winds, his apparatus destroyed and his very life jeopardised, a statue has been erected to his honoured memory and inaugurated amidst public applause. In America, where he found a refuge,—not quite unassailed—the chemists of the great republic have met at his grave as the most suitable spot for a retrospect of the progress of chemistry. Their celebration was unclouded with any painful and humiliating memories. They could pay their tribute to the great departed with free spirits. Not so we on this side the Atlantic. Our festive ceremonial was at the same time an act of national penitence. We remember with shame the folly and the brutality of our forefathers. We blush for the statesmen, the magistrates, the clergy, the publicists who instigated this outrage and applauded its perpetrators. We ask ourselves, too how far we are really removed from scenes like the great Birmingham riot. No writer, lecturer, or thinker is now, indeed, in peril of having his house pulled down. But do not recent—very recent—events warn us that our vaunted toleration of unpopular opinions is merely

> "The inquisition rebaptised,
> The old brute torture spiritualised."

As a proof of the hatred which has followed the memory of Priestley, even into the second half of the present century, we may mention that, in 1851, a chemist—whose name is immaterial—delivered at a Mechanics' Institute near Manchester a lecture on the life and discoveries of Priestley. For this he was threatened with the loss of an appointment which he at that time held, and was subjected to every practicable mode of persecution and annoyance. This was the more gratuitous, since in the lecture he confined himself strictly to a review of Priestley's chemical and physical researches, and entirely abstained from discussing his theological and metaphysical labours. If, then, we as a nation have learnt to take a calmer and a higher view of Joseph Priestley, and if we feel, as we ought, sincerely ashamed of our conduct towards him, it must be owned that our progress since the year of the Great Exhibition has been rapid indeed. In the last century, the President of the Royal Society was asked to procure a refutation or condemnation of some of the electrical discoveries of Benjamin Franklin, on account of the republican and rebellious character of the American philosopher. In this century a man has been forbidden to lecture on the discovery of oxygen, because its discoverer was a unitarian in religion! It is hard to say which demand was the more absurd and the more tyrannical.

From a scientific point of view the position of Priestley is most remarkable. At no period of his life did chemistry take up the whole or even the greater part of his time and attention. It may even be doubted whether he was thoroughly well acquainted with the science as then understood. Yet in spite of these drawbacks he was able to make the most remarkable and fruitful discoveries. There is perhaps no second instance of a man achieving such great things for science amidst so many distracting pursuits. Some persons have regretted the multifarious character of his studies, and have maintained that he might and would have accomplished far greater things had he confined himself to one subject. We do not share this view. Priestley acted in accordance with his own faculties, character, and early training, and the result is patent to the world. Had he flourished at an earlier date chemistry would probably have never attracted his attention. If now living he would probably never have been able to attain the nicety of modern experimental research, and would not have taken time to master the intricacies of modern theories. Coming upon the stage when he did he was able to render the most important services to science and to the world and to win for himself an undying reputation. It is singular that so ardent a reformer in politics and theology should, in chemical theory, prove so decided a conservative. Curious, too, that he should to the last defend the phlogiston theory which his own discoveries had undermined.

All honour, however, to the martyr of Birmingham, and may his memory ever prove a band of brotherhood between the men of science in the land of his birth and in that of his death.

* From the *American Chemist*, Nos. 50 and 51, 1874.

THE VERTICAL LANTERN.

At the late Industrial Exhibition of the Franklin Institute in Philadelphia, as also at the like Exhibition of the American Institute in New York, silver medals were awarded for the apparatus shown in the accompanying figure, which is manufactured by Messrs. George Wale and Co., instrument makers to the Stevens Institute of Technology, Hoboken, N.J.

In its present remarkably efficient state of development this apparatus owes much to one of our frequent contributors, Professor Morton, as well as to the mechanical ingenuity of Mr. Wale, and has gone into very general use in the principal colleges of the United States.

The cut (taken from a photograph) shows the apparatus as adjusted to exhibit on the screen such objects as waves in water, cohesion figures, and the like.

The light from the lime cylinder or electric arc passes through two large lenses, by which it is thrown in a parallel beam on an inclined mirror in the triangular box in front. By this it is reflected upwards, and is condensed by a large lens standing horizontally on top of the same triangular box, so as to pass into the objective above, and is then by the small upper mirror thrown on a screen. This upper mirror, with the objective, is carried by a bar provided with rackwork, by which an accurate adjustment for focus can be made.

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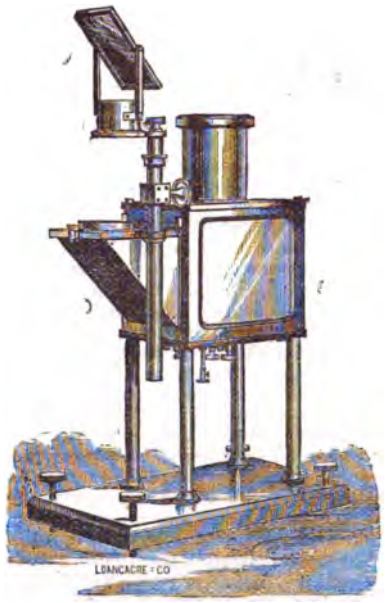
The objects rest directly on the plate holding the large horizontal condenser. When the apparatus is to be used for ordinary objects which can be held in a vertical position, a little screw in the front of the horizontal plate is



taken out, and then the triangular box carrying the lower mirror is removed, allowing the horizontal plate to swing down into a vertical position, carrying with it the rack-work bar and objective into their proper positions.

NOTICES OF BOOKS.

Address Delivered before the British Association, assembled at Belfast, with Additions. By JOHN TYNDALL, F.R.S., President. Seventh Thousand. London: Longmans, Green, and Co.

THE interest excited by this Address when first delivered in September last, seems far from diminishing. It certainly lays before the public no novel facts, the fruit of recent research; no profound and startling generalisations, heretofore strange to the general public. There is nothing which was not fully known to men of science, and not only so, but to all persons of respectable culture. Nor is any new mode of philosophising recommended for the first time. As the author reminds us in his preface, he has, in former essays and papers, claimed for Science the right of passing the bounds of experience, and this claim has provoked no general outcry. Yet now any one not alive to the progress of discovery for the last quarter of a century, and to the views prevalent among the most advanced thinkers, might be led to suppose that some great and alarming revelation had been for the first time announced. The sermons, lectures, resolutions, memorials, letters, and leaders which have appeared on the subject would form, in themselves, almost a library. On the other hand, Prof. Tyndall has published his Address first with one preface, explanatory and controversial, and subsequently with a second. In these prefaces we are bound to declare that there is no appearance of, and no attempt at, recantation. What he said at Belfast the author is willing to abide by. He explains, but he does not seek away. Only, and with fullest right, he objects to being held responsible for words which he never uttered. Of that sophism which consists in imputing to an opponent views he has never expressed the anti-Tyndallian writings furnish typical specimens. We might assume that any one claiming the position of a scholar and a gentleman would, before uttering a severe and sweeping condemnation of an Address like that before us, at least have taken the trouble to read it, and any available documents bearing upon it. To neglect such easy means of arriving at the truth is more than irrational,—it is profoundly immoral. We quote an instance from the author's earlier preface:—"An evening paper of the first rank, after the ascription of various more or less questionable aims and motives, proceeds to the imputation that I permitted the cheers of my audience to 'stimulate' me to the utterance of words which no right-minded man, without a sense of the gravest responsibility, could employ. I trust the author of this charge will allow me, in all courtesy, to assure him that the words ascribed by him to the spur of the moment were written in Switzerland; *that they stood in the printed copy of the Address from which I read;* that they evoked no 'cheers,' but a silence far more impressive than cheers."

To take another instance:—"In the *Times* of Nov. 9th he (the Bishop of Manchester) is reported to have expressed himself thus: 'In his lecture in Manchester Prof. Tyndall as much as said that at Belfast he was not in his best moments.' Now, considering that a *verbatim* report of the lecture was at hand in the *Manchester Examiner*, and that my own corrected edition of it was to be had for a penny, the Bishop, I submit, might have afforded to repeat what I actually said, instead of what I 'as much as said.' I am sorry to add that his rendering of my words is a vain imagination of his own. In my lecture at Manchester there was no reference, expressed or implied, to my moods in Belfast." Such cases as these need, surely, no comment.

But, ably as Prof. Tyndall deals with those of his assailants whom he selects from the throng, it is questionable whether these prefaces are not a mistake. If he has advanced too confidently the hypotheses as yet doubtful,—if he has strayed too far from the clear daylight of the inductive philosophy into a visionary twilight,—he must be judged by his peers, by men of science, not by ecclesiastics. To the Cullens and the Magees, the Frazers and the Capels, his plea ought to be "*non coram judice.*"

We cannot here pass over the claim advanced by Monsignor Capel as to the right of his Church, or any Church, to determine what true Science is. Such claims have not even the shadow of validity. We should as readily accept the decision of the Committee of the Stock Exchange, or of the Guardians of St. Pancras! Only men of science, acting as such, have either the right or the power to pronounce what true Science is. The mere attempt on the part of others, be they prelates or ploughboys, is intrusive charlatanism.

Into an examination of the views put forward by Prof. Tyndall we can the less enter as the Address touches not at all upon Chemistry, and scarcely upon Physics. Its main sphere is the science of life. The main questions which it raises relate to the passage from the inorganic to the organic, to the origin of sensibility and consciousness. These are subjects which have hitherto defied explanation, and have been set apart as inscrutable mysteries before which man must be content to pause and wonder. There are minds who enjoy such a position, and who positively applaud when Science is obliged to confess her limitations. But the true philosopher will never exchange Bacon's inspiring watch-word "*Plus ultra!*" for an anile "Rest and be thankful." As in inorganic science, we shall from failure learn the secret of success. A Roman senate went out to salute Varra, the defeated of Cannæ, because he had not despaired of his country. Can we pay any smaller tribute to the minds who are now grappling with the most difficult problems that have ever confronted human intelligence? They may be mistaken, more or less gravely, but they are, at least, working. Is it seemly that their

attention should be distracted by the discordant cries of those who, in former ages, reviled—in the same manner—Copernicus, Kepler, Galileo, and Newton?

The Induction of Sleep and Insensibility to Pain by the Self-Administration of Anæsthetics. J. M. Crombie, M.A., M.D. London: J. and A. Churchill,

The object of this pamphlet is to describe an apparatus by means of which patients requiring relief from pain may conveniently administer anæsthetics to themselves. The author points out that in self-administration there is little or no fear of an over-dose, since "the inhalation of the vapour ceases whenever the patient begins to sleep, and this because it is dependent on certain movements of the hand, which are arrested by the approach of sleep." Whilst fully admitting the value of this idea, we cannot refrain from asking whether there is not a certain element of danger in facilitating the self-administration of anæsthetics? An old medical friend of ours contends that the growing love for narcotics, anæsthetics, and in short for whatever is "soothing," is a most serious symptom of physical degeneracy in the human race, and that these drugs, in the long run, augment the very evils which they temporarily relieve.

Report of the Sanitary Committee of the Board of Health on the Concentration and Regulation of the Business of Slaughtering Animals in the City of New York. New York: D. Appleton and Co.

It is small consolation to us in London to learn that New York is suffering from the same sanitary—or rather unsanitary—evils as ourselves. On both sides of the Atlantic Science has pleaded long and earnestly against intramural graveyards, slaughter-houses, cesspools, sewers ventilated *into* streets and dwellings, &c. It now only remains for fever, cholera, and dysentery, to speak in tones which even the deafest and most vested-interest-ridden public cannot fail to hear. The only misfortune is that the innocent must suffer with the guilty, and the scorned and neglected prophet perish with those whose purblind selfishness opposed his teachings.

The New York Board of Health propose to abolish all slaughtering of cattle within the city, and to establish *abattoirs* in suitable places. We wish them success in so necessary an undertaking.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 23, December 7, 1874.

Results produced by the Joint Action of a Battery and of Electro-capillary Currents.—M. Becquerel.—The author has investigated the possibility of augmenting or decreasing the intensity of electro-capillary action by the aid of the current of a battery of several elements. Among the bodies experimented upon was the chloride of chrome, which yielded an intense black deposit. This was found to be a hydrated sesquioxide of chrome; the black colour is due to some peculiar molecular arrangement, and the crystallisation belongs to the regular system. Perchloride of iron yielded also a black, crystalline deposit consisting of hydrated sesquisulphide. Chloride of bismuth also deposited the sulphide of the metal. Acetate of lead deposited metallic lead in a very brilliant state. Nitrate of copper yielded a brilliant deposit of metallic copper on the negative surface and crystalline sulphide of copper on the other. With the chlorides of gold and of zinc no decomposition was produced. The apparatus consisted of a split tube containing the solution to be experimented upon, and plunged in a larger tube containing a solution of an alkaline sulphide. The action was augmented by means of two slips of platinum in connection with a battery, the positive being immersed in the metallic solution and the negative in the sulphide.

Intervention of Physico-Chemical Forces in Vital Phenomena.—M. Becquerel.—The author thinks that the electro-capillary forces play the greatest part in organic beings. These forces requires for their production merely permeable tissues separating two liquids of different natures, and find, consequently, in the organism the conditions necessary for their origin. Their existence, direction, and intensity are easily proved. The author found arterial blood negative with venous blood, instead of being positive as M. Scoutetten announced.

On Magnetism.—M. J. M. Gaugain.—A continuation from *Comptes Rendus* Jan. 13th, June 30th, Sept. 8th and 29th, Nov. 10th, and Dec. 2nd, 1873; and March 22nd, June 1st and 15th, Sept. 7th, and Oct. 5th, 1874. It is not adapted for abstraction.

Ureides of Pyvuric Acid, Synthesis of a Homologue of Allantoin.—M. E. Grimaux.—(See *Comptes Rendus*, 1874, vol. lxxix., p. 526.) Uric acid and its congeners, sarcin and xanthine, appear to be derived from the residues of aldehydic or acetonic acids. The author has studied the action of urea on an acetonic acid, the pyvuric, in order to obtain bodies of a constitution analogous to those of the uric series. In a former communication he has shown that this reaction is very complex and gives rise to divers bodies according to the relative proportions of acid and of urea. In the present memoir he describes the derivative obtained when an excess of urea is allowed to act upon pyvuric acid. To prepare it, two parts of urea, finely powdered, are moistened with one part of the acid boiling at 160° to 170°, and the mixture is kept for some hours at 100°. The mass becomes liquid, gives off pure carbonic acid, then it grows turbid, and is filled with a solid matter. When the reaction is over the whole is taken up in an excess of boiling alcohol, filtered, and the residue dissolved in ten times its weight of boiling water. The filtrate, on cooling, deposits white brilliant crystals, of the composition $C_5H_8N_4O_3$. This body, pyvurite, is insoluble in alcohol and ether, sparingly soluble in boiling water, but soluble in ten times its weight of boiling water. It dissolves in ammonia, but without forming with it a combination. If dried in the air it does not lose water below 145°. At 155° it begins to lose weight and is converted into a new substance, insoluble in boiling water but soluble in alkalies, whence it is re-precipitated by all acids, even the carbonic. If more strongly heated, pyruvite is destroyed without melting, giving off cyanic and ammonical vapours, and leaving a residue of charcoal. If boiled with baryta water it yields urea, of which a part is converted into carbonate of ammonia, oxalate, and a small quantity of a soluble salt of baryta. Pyruvite does not precipitate metallic salts, except with nitrate of mercury, with which it forms a copious white precipitate, A mixture of aqueous solution of pyvurite and of nitrate of silver gives a bulky white precipitate on the addition of potash.

Observations on the Species of the Genus Phylloxera.—M. Signoret.

Method followed for the Discovery of the Substance most Efficacious against the Phylloxera, at the Viticultural Station at Cognag.—Max Corny.

Solutions of Chrome Alum.—M. D. Gernez.—It is generally admitted that solutions of chrome alum which have been rendered green by heat return spontaneously and gradually to the violet modification, and deposit the alum in the shape of regular octahedra. On the other hand, the crystals have been known to remain green for months without depositing alum. If we make a hot con-

centrated solution of chrome alum in vessels which are sealed at the lamp while boiling we observe that, however concentrated the solution, it does not, at common temperatures, deposit crystals of violet alum. Moreover, contrary to the assertions of M. Lecoq de Boisbaudran, it does not take the tint of solutions made in the cold, even after a very long time. These green solutions, preserved from contact with a crystal of alum and submitted to slow evaporation, whether by heat or in the dry vacuum of the air-pump, give as residue a solid, transparent matter, of an emerald green. This residue is the same, whatever may be the state of dilution of the original solution, and it preserves the same colour and appearance for more than a year. If instead of evaporation it is exposed to intense cold, crystals of alum are not produced. But a solution produced at the same temperature and not modified by heat yields when exposed to cold violet octahedral crystals of alum. If the vessels containing the green saturated solution are opened and the liquid touched with a crystal of chrome alum, a violet crystallisation begins and gradually increases. This effect may be produced by the contact, not merely of chrome-alum, but of any alum whatsoever. Those of potash, ammonia, iron, and thallium produce violet crystals, like chrome alum itself, contrary to the assertion of M. Lecoq de Boisbaudran. But the contact of crystals other than alums is unable to induce the crystallisation of the supersaturated solution.

Transformations of Persulpho-cyanogen.—M. J. Ponomareff.—The author has studied the action of perchloride of phosphorus and of ammonia upon persulpho-cyanogen.

Transmission and Inoculation of the Virus of Carbuncle, &c., by Flies.—M. J. P. Megnin.—The author finds it proved that certain blood-sucking flies with rigid and penetrating probosces, such as the *Glossinæ* (Tsetse flies), *Simulia*, &c., may effect the transmission of virulent maladies, and among others, of carbuncle.

Reimann's Farber Zeitung, No. 43, 1874.

This number contains remarks on the recent rise in the price of raw aniline and consequently of aniline colours; receipts for a cerise on woollen yarn; a marine blue on mixed woollen and cotton goods (both pieces and garments); and a fast black on cotton yarn.

There is the continuation of a paper on the removal of "burls" from wool by chemical means.

Böttger gives the following process for the manufacture of corallin. 1 part of crystalline oxalic acid, 1½ parts of phenol, and 2 parts of oil of vitriol are heated for five to six hours to 140—150° C. The resulting mass is poured into hot water and boiled. There is thus obtained a resinoid product, brittle when cold, and with a green metallic surface reflection; when ground it yields an orange-red powder.

Daudenart and Verbert patent a process for utilising the waste water from scouring wool. It is mixed with a solution of caustic baryta as long as a precipitate is formed. When this has settled the clear liquid is drawn off, evaporated to dryness, and the residue ignited, yielding a mixture of potash with a little chloride of calcium. (In England soda would be generally found in place of potash). The fatty acids are separated from the precipitate by means of hydrochloric acid, washed, and pressed. The solution of chloride of barium is mixed with hydrate of magnesia, and carbonic acid is passed into the mixture until all the baryta is precipitated. Finally the carbonate of baryta is re-converted into caustic baryta by ignition with charcoal.

Prof. A. W. Hofmann has found phenylen-diamin ($C_{12}H_5N_2H_3$) in aniline oils boiling at high temperatures, *i.e.*, between 270° and 300°. It is a solid, crystalline body, boiling at 280°. The crystals melt at 63°. It was formerly made directly from binitro-benzol. Its occurrence in the above mentioned aniline oils is explained by the circumstance that in nitroising artificial impure benzol not merely nitro-benzol but also binitro-benzol is formed, which by subsequently taking up hydrogen becomes phenylen-diamin. If the substance can be obtained in quantity, it may possibly serve for the preparation of phenyl-brown (Manchester brown), which has been already used in dyeing with success.

No. 44, 1874.

This number contains receipts for a marine blue on woollen pieces, garments, or yarns; for a deep aniline blue on mixed woollen and cotton garments; and a yellowish mode on mixed stuffs and garments.

An adventurer is going about Germany selling receipts for a "new brilliant black" and a "cheap brown." The former is produced by boiling the goods with lead-ore and soda, and the latter with truffles (!) 20 to 30 lbs. of which suffice for 100 lbs. of cloth.

Then follows a receipt for a Guernsey blue on woollen yarn and for preparing *trame* silk.

No. 45, 1874.

The editor points out that soluble glass "free from amorphous silica" is being offered to dyers as a particularly valuable article.

There are receipts for a blond, a light olive, and a stone-grey on wool; a coffee-colour on woollen yarn; an aniline violet on wool and cotton rags; an olive and a reseda on wool and cotton garments; a peacock-blue on cotton yarn, and a white on silk.

For printing a Prussian blue Scheurer dissolves the colour in alkaline tartrate of ammonia. 50 parts tartaric acid, 190 ammonia, and 110 dry powdered Prussian blue, are dissolved together in 150 parts of water and thickened with an equal weight of tragacanth mucilage. The goods are printed with this mixture, dried, and passed through sours, which developes the colour. For dyeing the goods are steeped in the liquid—without thickening—dried and soured. The colour is very fast.

Moniteur Scientifique, du Dr. Quesneville, November, 1874.

Formation of Molasses.—F. Anthon.—Chemists are not agreed on the origin of molasses. Some maintain that its formation is due to non-crystalline organic bodies, gums, extractive, &c. Others hold that it is produced by the presence of mineral salts in the saccharine juice. Lastly, a third party believe that the substances "other than sugar" may be classified as (*a*) generators of molasses; (*b*) indifferent; and (*c*) preventers of molasses. The author shows that chloride of calcium, added in small quantities, decreases the yield of molasses. But if added in large excess it prevents altogether the crystallisation of sugar, and the whole mass becomes molasses. Hence one and the same body may be either regarded as promotive or preventive of the formation of molasses, and the above classification must fall to the ground.

Preparation of Saffranin.—A. Ott.—The author recommends as the best method to treat with syrupy arsenic acid the azotised compounds obtained by acting with nitrous acid upon heavy aniline oils containing toluydin, and boiling at 198° to 200°. For the preparation of the nitrous acid he takes 1 part of starch and 8 of nitric acid, heating in the water-bath; the gas generated before being conducted into the aniline oil is not washed in water, but passed through sulphuric acid. When the aniline has become a maroon-brown, and crystallises on a watch-glass, 100 parts are mixed with 90 parts of arsenic acid at 72 per cent. To prevent a too rapid rise of temperature the arsenic acid is introduced very gradually. The mass is then heated on the sand-bath till a violet colouration appears. According to Reimann (*Farber Zeitung*, No. 41, 1871) the application of heat for five minutes is sufficient. The author finds that in operating upon 50 grms. it is necessary to heat for at least two hours. The whole is

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then boiled with water containing lime, in which the violet colouring matter is insoluble. To remove the deposit formed the whole is poured upon flannel filters, beneath which is a layer of sand. The filtrate is slightly saturated with hydrochloric acid, and an excess of chloride of sodium is added. The precipitated saffranin is purified by solution in acidulated water, and re-precipitation with salt.

Gazzetta Chimica Italiana, Anno iv., Fascicolo 6, 7, and 8, 1874.

Isomerism of Aromatic Bodies with Six Atoms of Carbon.—W. Koemer.—A paper occupying nearly 150 pages, and incapable of being usefully abstracted.

Action of Hydriodic Acid on Santonic Acid.—S. Cannizaro and D. Amato.—A preliminary notice.—The direct product of the action is a hydrocarbon of the composition $C_{15}H_{24}$.

On Meta-Santonin.—S. Cannizaro and D. Amato.—Meta-santonin has the melting-point 160·5°. It is not affected by the action of the air or of light; it forms prismatic crystals, and under a pressure equal to 10 m.m. of mercury it melts at 238° to 240°. It is tolerably soluble in hot, but sparingly soluble in cold water; very soluble in ether and alcohol; most soluble in an aqueous acid solution formed by the action of water upon the iodide of phosphorus. Solution of potassa does not seem to have any effect upon it.

Quantitative Determination of the Atomic Group C_2H_3O contained in Acetyl Substitution-Products.—Fausto Sestini.—A known quantity of the acetylic derivative is placed in a suitably-arranged recipient with a measured volume of normal solution of caustic soda, and is heated to 100° for some hours. Into the cold liquid is poured a volume of normal solution of sulphuric acid exactly equal to that of the alkaline solution employed. It is then filtered, the vessel and filter are well washed, and with the standard solution of soda the quantity of acetic acid produced by the reaction is determined.

Action of Bromine upon Anhydrous Chloral.—A. Ogliaforo.—The author expected to obtain the compound C_2Cl_3Br, or a chloro-bromide of the constitution $C_2Cl_3Br_3$, by treating, first chloral with bromine, and then making the pentachloride or chlorobromide of phosphorus act upon the compound C_2Cl_3BrO, which, according to every probability, should be formed. The action of bromine upon chloral is much more complex.

Allylate of Chloral.—A. Ogliaforo.—A preliminary notice.

Transformation of Benzamide into Aldehyd and Benzoic Alcohol.—Prof. J. Guareschi.—The author added about 45 grms. of benzamide in a retort to ten to fifteen times its volume of ether, afterwards a little water, sodium amalgam, and pure and dilute hydrochloric acid. The reaction was sufficiently regular and care was taken that the liquid remained always acid, hydrochloric acid being added by degrees. To guard against a rise of temperature, the vessel was kept constantly in cold water. About 1500 grms. of sodium amalgam were employed, containing 3 per cent of sodium. When the reaction was over, the ethereal liquid was separated; it was faintly yellowish, and had an odour of bitter almonds. This liquid, distilled in the water-bath, left a residue liquid and yellowish, which had an intense odour of bitter almonds. It was agitated with 3 or 4 volumes of a solution of bisulphite of soda of sp. gr. 1·27, to separate benzoic aldehyd. The aqueous liquid, separated and decomposed with carbonate of soda, contained a small quantity of benzoic aldehyd. Having washed two or three times with water the liquid which had not combined with bisulphite of soda, it was submitted to distillation; a little water passed over first, then a portion boiling at 200° to 212°. On submitting this to fractional distillation, there was found a portion boiling at 205·5° to 209°; this was benzoic alcohol, its boiling-point being raised by a trace of unaltered benzamide held in solution.

Action of Sulphur on Carbonate of Lime.—Egidio Polacci.—With reference to his former paper on this subject (*Gaz. Chim.*, t. iv., p. 245), that a mixture of flowers of sulphur, distilled water, and carbonate of lime gives, in two to three hours, an intense reaction of sulphuric acid.

Production of Ozone by means of Electric Discharges.—C. Giametti and A. Volta.—Not adapted for abstraction.

Necessity of Searching for Phosphorus in the Urine in Cases of Poisoning.—F. Selmi.—The nature of this paper appears from the title.

New Studies on Milk.—F. Selmi.—An investigation into the nature of the albumenoid substances present in milk.

Behaviour of Tannic Acid in Cultivated Soils.—M. Mercadante.—The author ascribes the barrenness of lands containing much tannic acid to its power of precipitating the black matter of composts, which should keep in a free and assimilable state the salts useful to vegetation.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 11, November, 1874.

This number contains a report on the effects of bruising oats for the food of horses, which, contrary to expectation, proved injurious rather than beneficial, the animals fed on ground oats being much more liable to sweat. The process of M. Dobelle, of Amiens, however, who merely flattens instead of grinding, is stated to give satisfactory results.

Reports on the Electro-catalytic Apparatus for Producing a Light, Invented by MM. Voisin and Dronier.—This apparatus is based on the same principle as the Doebereiner lamp, but by the intervention of electric action the catalytic effect is reinforced.

Mineral Industry at the Exhibition of Vienna, in 1873.—M. Gruner, a member of the International Jury.—A general view of the mineral statistics of the world.

Electrolytic Determination of Copper and certain other Metals.—An interesting paper which we may on a future occasion insert in full.

No. 12, December, 1874.

Mines of Pyrites of Wigsnoes, Norway.—M. F. Kuhlmann, jun.—The Wigsnoes mine is situate in the island of Karmo, on the west coast of the Scandinavian peninsula. It was discovered in 1865 by a French engineer, M. Defrance. The beds of pyrites are in contact with metamorphotic schist on one side, and on the other with *gabro*, known as hyperite and euphotide, composed of a granular mass of labradorite, white, green, and violet, strongly impregnated with smarage and diallage. It contains rock crystal, titaniferous iron, and garnets. The ore is generally composed of sulphuret of iron mixed with sulphuret of copper and furrowed with blende. The gangue is silica, with a little fluor spar and chlorite. Traces of carbonate of lime are also found. The average proportion of sulphur is 45 per cent, with 3 per cent of copper, though certain parts contain 12 to 14 per cent of that metal. Specimens of metallic copper are also found. Silver and gold occur only in very small quantities. Of arsenic there is not a trace, which greatly enhances the value of the ore for the manufacture of sulphuric acid.

Les Mondes, Revue Hebdomadaire des Sciences.
No. 12, November 10, 1874.

Decolourising Properties of Phosphate of Lime.—G. Collas.—The author maintains that to treat animal

charcoal with hydrochloric acid in the hope of increasing its decolourising power by removing the phosphate of lime is an error. He admits, however, that phosphate of lime has no action upon the colouring matter of madder.

No. 13, November 23, 1874.

Explosion at a Colour Manufactory.—On Wednesday, November 18, in the works of M. Poirier, manufacturer of aniline colours on a large scale, a retort containing nitrate of methyl, destined for the preparation of a new green, and heated to a high temperature under great pressure, burst suddenly with a report comparable to the discharge of several heavy cannons. Twelve of the workmen were severely wounded, two of whom are already dead, whilst twenty others sustained slighter injuries. The explosion was heard over all Paris, at Vincennes, Meudon, and St. Germain-en-Laye. The accident is ascribed to the imprudence of a workman, who, despite express prohibition, entered the shed with a lamp.

Conditions of the Sugar Manufacture.—M. E. Pesier. Whatever may be the details and the name of the procedure adopted, it is indispensable to admit only the juice obtained by tearing and pressing the tissues; in other words, the liquor from the rasps and the presses and avoid the products of boiling the beet-root; consequently, to leave no pulp in the juice. This necessity has arisen from the employment of filter-presses. To employ for defecation a dose of lime, so as to saturate the juice. To keep the defecated alkaline juice at a boil until the ammonia is completely expelled. The injection of steam or of carbonic acid, or mechanical agitation, promotes this object. Not to neutralise all the free lime with carbonic acid. To employ animal charcoal well burnt, well washed, and free from caustic lime, from sulphides, and from chloride of calcium. To avoid every stoppage, and even slowness in the operations. Finally, to evaporate as rapidly as practicable at the lowest possible temperature.

No. 14, December 3, 1874.

M. Chevreul has given in his resignation as Director of the Museum of Natural History.

Classification and Purification of Saccharine Juices by means of Baryta and Basic Phosphate of Ammonia.—The baryta is introduced in proportions suitable to combine with the mineral and organic acids present, and eliminate them by precipitation. Basic phosphate of lime is then added to the extent of 1 to 2 litres at 10° B. for each kilo. of baryta employed, and precipitates the lime. The application of heat expels the ammonia. Excess of the reagents must be avoided. These chemicals are much superior to blood and animal charcoal, the former of which introduces the germs of fermentation.

Tanning with Chloride of Zinc.—MM. Meutens and Kresser propose to employ chloride of zinc in tanning hides, and in preparing a size for paper, incapable of putrefaction, and very slightly hygroscopic.

New Process for Converting Sulphate of Soda.—Carbon has the property of converting sulphate of soda into silicate in presence of silica, sulphurous acid and sulphnr being given off. The process is conducted at a red-heat in retorts like those used for coal-gas, and heated in a similar manner. The sulphur is collected by condensation. The sulphurous acid may either be converted into sulphuric acid in the usual manner, or else it may be absorbed in carbonate of soda, yielding bisulphite of soda, which, when treated with zinc, yields the "hydrosulphite" now used in indigo dyeing.

Alcoholic Yeast.—This substance when dried can endure for some hours a temperature of 100°, and for a shorter time even 130°. In its normal state, containing water, it can endure cold amounting to −113° without becoming disorganised.

Theory of Gases.—Professor Puschl.—It is customary to ascribe the pressure of gases to the shock of their atoms moving freely in all directions. According to this supposition, the calorific equivalent required to occasion, in a volume of gas $=v$, a pressure $=p$, will be—

$$\frac{3pv}{A}$$

A being the equivalent of duty of the calorific unity. For a gas containing no other heat, the ratio k of specific heat to the pressure constant at that heat, the volume being constant will be $\frac{1}{3}$. The maximum value found, in reality, is $k=\frac{1}{4}$, a close approximation. Clausius assumes, even in the chemical elements in a gaseous state, an internal atomic heat without influence or pressure. M. Puschl admits that a volume, v, of any fluid, submitted to a pressure, p, contains a caloric equivalent—

$$\frac{pv}{A}$$

resulting from the condensations and rarefactions of its smallest elements of volume; and that although exciting locally differences of pressure and temperature, this equivalent influences neither pressure nor temperature in their totality. Taking this calorific equivalent into account, the minimum of heat which we can suppose in a gas is—

$$\frac{5pv}{2A},$$

and not—

$$\frac{3pv}{2A}$$

as generally supposed; k, therefore, $=\frac{1}{4}$.

Electricity.—Professor Bolchmann has verified a series of formulæ relative to experiments on dielectric action at a distance, as also the dielectric constant of sulphur according to the difference of directions in reference to the optic axes in which the electricity acts. This constant, in fact, differs according to these directions, and in conformity with the theory of Maxwell, if we admit that the luminous take place normally in the plane of polarisation. The author has also determined the dielectric constant of glass, quartz, calc- and fluor- spars, and of selenium, both for permanent and alternating charges.

No. 15, December 10, 1874.

This number contains no chemical matter.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliques a l'Industrie, September and October, 1874.

This number contains no chemical papers, except such as have already been noticed in the CHEMICAL NEWS from their original sources.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 11th.—Royal Geographical, 8½.
—— Medical, 8.
—— London Institution, 5.
TUESDAY, 12th.—Civil Engineers, 8.
—— Photographic, 8.
—— Anthropological, 8.
—— Royal Institution, 3. E. Ray Lankester, Esq., M.A., "On the Pedigree of the Animal Kingdom."
WEDNESDAY, 13th.—Geological, 8.
THURSDAY, 14th.—Royal, 8½.
—— Chemical, 8.
—— Royal Society Club, 6½.
—— London Institution, 7.
—— Royal Institution, 3. Prof. P. M. Duncan, F.R.S., "On the Grander Phenomena of Physical Geography."
FRIDAY, 15th.—Royal Institution, 9. Prof. Tyndall, D.C.L., LL.D., F.R.S., "Some Acoustical Problems."

TO CORRESPONDENTS.

F. H. Storer, W. E. A. Aikin, J. Fallon, H. C. Bolton.—Received with thanks.

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THE CHEMICAL NEWS.

VOL. XXXI. No. 790.

ATTRACTION AND REPULSION RESULTING FROM RADIATION.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from page 13.)

32. When the balance was in air of ordinary density, and the hot body was placed *above* the pith ball in the position *a* (see fig. 2), it will be remembered that the action was to cause the ball to rise: the rising was, however, less decided than when the heat was applied below (27, 29). On re-exhausting the balance-tube and taking a series of observations, placing the hot bulb above the pith ball in the position *a* (fig. 2), instead of below it, the ascending tendency of the pith got less and less. Several millimetres below the previously ascertained point of neutrality the hot bulb at *a* ceased to exert an action, and when the neutral point was exceeded by some millimetres I could still detect no movement. However, at 2 millims. below a vacuum, I detected a tendency of the pith to sink when the experiment was tried, and in a good Sprengel vacuum there was an unmistakable repulsion exerted between the two bodies, the pith sinking in obedience to the radiation from above almost as strongly as it rose when the heat was applied beneath.

33. I now wish to ascertain the effect of cold on the balance pith balls, and for this purpose a lump of ice was employed.

The experiments were first tried with the balance-tube full of air, cold being applied either above or below the pith ball; a lump of ice generally produced an upward movement of the pith, but it was very faint, and sometimes the motion appeared to be in the opposite direction. It was evident that the true action of a cold body, whatever it might be, was here masked by currents of air; and I therefore exhausted the apparatus and tried the effect of ice at the previously ascertained neutral point, viz., at about ½ millims. below the vacuum. It was absolutely inert. I then carried the exhaustion to the fullest extent, testing the balance with ice during its progress. As the gauge approached nearer and nearer to the height of the barometer, the ice commenced to attract the pith; and at last, when the gauge and barometer were level, the attraction of the ice, whether applied above or below, was very marked, being exactly opposite but equal to the action of the bulb of hot water.

34. In trying some of these experiments in a Sprengel vacuum an action was noticed which led me to think that some of these movements might be due to electricity. When a hot glass rod is held motionless against the lower side of the exhausted tube, the repulsion of the pith ball takes place in a perfectly regular manner; but if the glass rod has been passed once or twice through the fingers, or if it is rubbed a few times sideways along the exhausted tube, the beam immediately moves about in a very irregular manner, sometimes being repelled from and at others attracted to the side of the tube, where it sticks until the electrical excitement subsides. When the finger is rubbed against the exhausted glass tube, the same electrical interference takes place; attractions and repulsions occur by fits and starts, the pith sticks to the tube, and does not regain its ordinary state for some hours. When a small spirit-flame is passed beneath the pith end of the balance in the vacuum, a similar but much fainter electrical effect is noticed. This, however, is not sufficient to interfere with the repulsion due to radiation unless the vacuum is very good and free from aqueous vapour.

35. The end of a glass beam in a Sprengel vacuum was found to be attracted by either pole of an induction-coil, when the other pole was not well insulated.

FIG. 4.

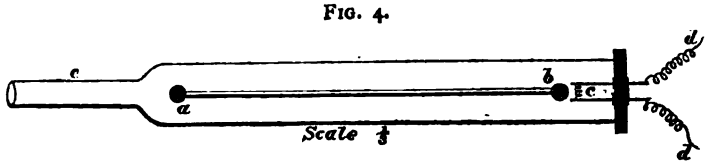


FIG. 4A.

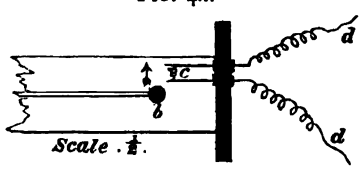
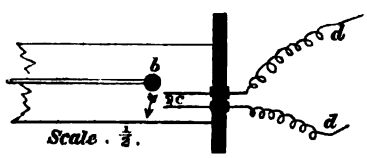


FIG. 4B.



To ascertain whether electricity exerted any special action in the ordinary repulsions in vacuum, the following experiments were tried:—

36. A straw beam with pith extremities was enclosed in a tube (24) and exhausted to the full power of the Sprengel pump. After adjustment by heat, till it was in equilibrium and very delicate to slight radiation, it was re-exhausted and hermetically sealed up. The tube was then completely surrounded with wet blotting-paper, with the exception of a small aperture through which the movement of the beam could be observed; the blotting-paper was connected to earth by a wire soldered on to a gas-pipe.

On bringing a piece of warm copper beneath the pith ball, it rose as readily as if the outside of the tube had been dry and insulated. The finger moistened with warm water also repelled the pith; and when cooled with melting ice, and then applied dripping wet either above or below the pith ball, there was attraction. The same result, but more strongly marked, took place when a piece of ice was used instead of the cold finger.

A straw beam furnished with brass balls at each end* was suspended in the usual manner on a double-pointed needle; and the brass balls and needle were placed in metallic connexion by means of a very fine platinum wire. The needle did not rest on the sides of the glass

* From the *Philosophical Transactions of the Royal Society of London*, vol. clxiv., par 2.

* Preliminary experiments showed me that the brass balls on th straw beam acted in every respect the same as the pith balls, wit regard to hot and cold bodies externally applied, both at ordinar pressures and in a vacuum; but they moved in a more sluggis manner.

tube but in steel cups, to which was soldered a platinum wire passing through the glass tube and connected to earth. The tube was then exhausted, and the usual experiments tried with hot and cold bodies, both with and without a wet blotting-paper cover. In all cases the brass balls behaved normally, being repelled by heat and attracted by cold.

These experiments show that electricity is not a chief agent in these attractions and repulsions, however much it may sometimes interfere with and complicate the phenomena.

37. I now wished to see the effect of applying to the gravitating masses a hot body inside the exhausted balance-tube instead of outside, and accordingly constructed an apparatus shown in fig. 4.

a, *b* are two balls suspended on a straw beam; *c* is a platinum spiral fastened to two stout copper wires cemented into holes drilled through a plate of glass, which can be cemented to the end of the tube; *d*, *d* are the battery-wires: *e* is the extremity of the tube, drawn out for attachment to the Sprengel pump. A single Grove's cell served to heat the platinum spiral to redness. By careful management and turning the tube round the necessary degree, I could place the equipoised brass ball either over, under, or at the side of the source of heat. A contact-key enabled me to heat the spiral without removing the eye from the micrometer. With this apparatus I wished to learn more about the behaviour of the balance during the progress of the exhaustion, both below and above the point of no action, and also to ascertain the pressure corresponding with this critical point.

In air of ordinary density the action of the hot spiral was one of attraction both above and below. Not wishing, however, to complicate the action by air-currents, I exhausted with the Sprengel pump until the gauge stood about 40 millims. below the barometer. I then tried the following experiments:—

38. The brass ball was placed so that its position when in equilibrium was about 1 millim. above the spiral, and the latter was rendered incandescent. The ball was immediately drawn down to the spiral, sometimes touching and then rebounding with considerable force.

39. The brass ball was then arranged so that it was about 1 millim. below the spiral. On turning on the battery-current the ball rose to the hot platinum. This latter action might be due to air-currents; but it is difficult to imagine that air-currents could drag the ball down to the hot spiral when the latter was beneath it (38).

40. The ball was arranged so that the platinum spiral was opposite the end, but a little above, as shown in fig. 4A. On igniting the spiral the movement was very slightly upwards. When the spiral was rather below the ball, as shown in fig. 4B, the ball moved downwards when contact with the battery was made; the tendency in each of these cases was to bring the centre of gravity of the brass ball as near as possible to the source of heat.

41. The pump was then worked until the gauge had risen to 5 millims. of the barometric height. On arranging the ball above the spiral and making contact, the attraction was still strong, drawing the ball downwards a distance of 2 millims.

The pump continuing to work, the gauge rose until it was within 1 millim. of the barometer. The attraction of the hot spiral for the ball was still evident, drawing it down when placed below it, and up when placed above it. The movement was, however, much less decided than before, and in spite of previous experience (30, 31) the inference was very strong that the attraction would gradually diminish until the vacuum was absolute, and that then, and not till then, the neutral point would be reached. Within 1 millim. of a Sprengel vacuum there appeared to be no room for a change of sign.

42. The gauge rose until there was only half a millimetre between it and the barometer. The metallic hammering heard when the raefaction is close upon a acuum commenced, and the falling mercury only occasionally took down a bubble of air. On turning on the battery-current, there was the faintest possible movement of the brass ball in the direction of attraction.

43. The working of the pump was continued. On next making contact with the battery, no movement of the ball could be detected. The red-hot spiral neither attracted nor repelled. I had arrived at the critical point. On looking at the gauge I saw it was level with the barometer.

(To be continued.)

LECTURES ON THE MORPHOLOGY OF CRYSTALS

AT THE

CHEMICAL SOCIETY.

By NEVIL STORY MASKELYNE, M.A., F.R.S., &c.

Lecture III.

Having thus far treated of some of the simplest relations of crystal faces as referred to a system of axes crossing one another at right angles, the lecturer proceeded to indicate the methods by which such relations may be also established between the faces where either no axes perpendicular to each other are furnished by edges of the crystal, or where, for other reasons, axes oblique to each other are selected. And, first, he pointed out the general features of a crystallographic axial system. Such a system will present, in its most general form, three axes, X, Y, Z, inclined to one another, at angles—

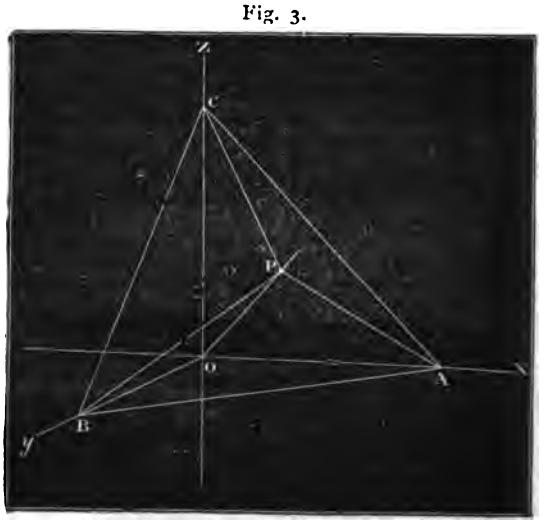
$$X\,Y = \zeta$$
$$Y\,Z = \xi$$
$$Z\,X = \eta$$

The parameters, also, in the most general case, $a : b : c$, represent two quantities, viz., $\frac{a}{b}$ and $\frac{c}{b}$, which will give the ratios of the intercepts of some assumed plane, viz., $\frac{a}{b}$ on the axis of X, 1 on the axis of Y, and $\frac{c}{b}$ on the axis of Z; hence, such a system presents five elements, viz.:—

$$\zeta, \eta, \xi; \frac{a}{b}, \frac{c}{b}.$$

It will also be observed that the space around the origin of the axes is divided by the three axial planes, XY,

Fig. 3.



YZ, ZX, into eight spaces, or compartments, termed octants, which may be characterised by the signs of the axes that include them.

The simplest way of referring the face of a crystal to such an axial system is by supposing a line to be drawn perpendicular to the face from the origin, as in Fig. 3. The line O P is drawn perpendicular to the plane A B C. Drawing the lines P A, P B, and P C, the triangles O P A, O P B, and O P C give us the following ratios:—

$$\frac{OP}{OA} = \cos.\ POA,\quad \frac{OP}{OB} = \cos.\ POB,\quad \frac{OP}{OC} = \cos.\ POC,$$

or $OP = OA \cos.\ PX = OB \cos.\ PY = OC \cos.\ PZ$. So another plane, H K L, would give the values—

$$OP' = OH \cos.\ P'X = OK \cos.\ P'Y = OL \cos.\ P'Z,$$

in which expressions O A, O B, O C are the parametral ratios $a : b : c$, while O H, O K, and O L have values like those before obtained for the comparison of two planes, viz:—

$$\frac{a}{h},\ \frac{b}{k},\ \frac{c}{l};$$

and, reverting to the original example, the plane 341 would be represented by the expression—

$$\frac{a}{3} \cos.\ P'X = \frac{b}{4} \cos.\ P'Y = \frac{c}{l} \cos.\ P'Z,$$

P' being the point where the perpendicular to the plane, henceforth to be called its *normal*, meets it: and the expressions previously obtained for an edge, a zone line, or a zone, are equally applicable when the axes are taken as oblique.

The next step to be taken is to extend this idea of normals drawn to all the planes of a crystal to that of their continuation until they meet the surface of a sphere which is supposed to be described round the origin of the axial system as its centre. The faces of the crystal may be conceived as drawn so as to be tangent planes to such a sphere; or, again, we may suppose their normals to be continued onwards through the planes until they penetrate the sphere's surface. In either case, the points at which they meet that surface will be termed the *poles* of those planes.

It is evident that by this means the situation of a plane is known when we know that of its pole upon the sphere. Any great circle of the sphere passing through a pair or a series of such poles will offer, in the arcs intercepted between them, the means of measuring the angles between their normals, which were shown to be supplementary to the angles between the planes themselves. Such circles connecting two or more poles will be called zone-circles, and they will evidently lie in the zone-planes of the zones by which they are designated. The calculation of the arcs of these great circles falls within the domain of spherical trigonometry.

The lecturer next made a digression into the subject of the different methods employed for the graphic representation of crystals; and, after alluding to the usual orthographic representation of their edges in the pictures met with in crystallographic treatises, he proceeded to consider the simple and comprehensive method afforded by projecting their poles in what is termed the stereographic projection. The eye, being supposed to look into the sphere from a point on its surface, sees the poles distributed on the hemisphere opposite to that point, as though depicted on a screen passing through the centre of the sphere, and bounded by the great circle of which the position of the eye would be the pole. All great circles of that opposite hemisphere are now projected on the plane dividing the sphere as circular arcs, except such as pass through the pole opposite to the eye, which are presented as straight lines passing through the centre of the circle of projection.

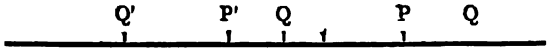
These points were illustrated by a working model, as were also the means of measuring arcs on a projected circle by drawing lines from its projected pole to the circle of projection. Methods for finding the centres for these projected arcs were also illustrated by the model in question.

The lecturer finally dwelt on the great importance to the student of familiarising his hand to the construction of projections of this kind, and his mind to the recognition, in the poles on the sphere, of the true relative positions of the faces of which they were the representatives; a familiarity easily acquired, and when acquired, facilitating the working of crystallographic problems, and the embodying within the outline of a single circle even the most complicated series of faces a crystal can present with a completeness offered by no other method.

LECTURE IV.

Mr. Maskelyne began his fourth lecture by a digression, in which he called attention to certain properties presented by the division of a line by three or more points. Supposing a line of indefinite length to have two points upon it, P and P' (Fig. 4), and supposing a third, and movable,

FIG. 4.



point, Q, to traverse the line in a direction towards P and P', then at any position of Q before it reaches P we have the ratio—

$$\frac{QP}{QP'} = \frac{QP' - PP'}{QP'} = 1 - \frac{PP'}{QP'},$$

and this ratio, when Q and P coincide, becomes zero; while, on the other hand, when Q was indefinitely remote from P, the fraction—

$$\frac{PP'}{QP'}$$

approximates to o, so that the decrease of the ratio was continuous from 1 to o, as Q moved towards P. Beyond P, as Q moves towards P', the ratio continuously increases until $QP' = o$, that is to say, Q and P' coincide, and the ratio becomes infinite, and midway between P and P' it obviously passes through the value—

$$\frac{QP}{QP'} = 1.$$

Beyond P' again, let Q become Q'; and now the ratio—

$$\frac{Q'P}{Q'P'}$$

continuously decreases from infinity to 1, as—

$$1 + \frac{P\ P'}{Q'\ P'}$$

approximates to $1 + o$.

If now we consider the ratios of the parts into which the line is divided internally to P P' by Q, and externally by Q', these ratios—

$$\frac{QP}{QP'} \text{ and } \frac{Q'P}{Q'P'}$$

offer us a series of values, among which, for every position of Q', there may also be found one corresponding position of Q, such that—

$$\frac{QP}{QP'} = \frac{Q'P}{Q'P'};$$

and this is what has long been known as the harmonic division of the line.

Reckoning magnitudes as positive in the direction P P', and negative in the direction P' P, we have—

$$\frac{PQ}{PQ'} = \frac{-P'Q}{P'Q'} \quad \text{or} \quad \frac{PQ}{PQ'} : \frac{P'Q}{P'Q'} = -1.$$

This equality of the ratios, however, is only a particular case of that more general proportion with which we have to deal.

Mr. Maskelyne then proceeded to state some of the more general properties presented by what have been called anharmonic ratios by M. Chasles. Thus, if four rays are drawn through a point, and any line cut these

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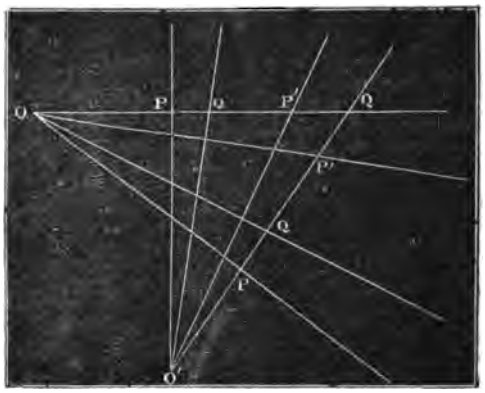
transversely in points P, Q, P', Q', the ratios in question remain the same, whatever be the direction taken by the transverse line. And if four other rays (Fig. 5), proceeding from another point, meet the former four severally at right angles, the ratios are the same for each sheaf of

Fig. 5.



rays; and, further, the sines of the angles contained by these rays, taken in the same order as the points on the original transverse lines, have also identical ratios with the corresponding divisions on a transverse line.

Lecture V.

In reverting to the subject discussed in the last lecture, Mr. Maskelyne showed that, if two of the rays in a sheaf of four be perpendicular to each other, and one of them bisect the angle between the remaining two, the ratios of the sines of their angles become harmonic.

Reverting from this digression to the subject of a zone, and considering the radii of a sphere drawn to a series of poles on the same zone circle, which represent, therefore, the normals of the planes of that zone, he stated, as one of the many contributions of Professor Miller to crystallographic science, that he had shown that the anharmonic ratios of the sines of the angles between any four such normals are identical in value with the corresponding ratios of the determinants of the symbols for the four planes. Consequently, we may say that the anharmonic ratios yielded by the normals of four tantozonal planes, and, therefore, also by the planes themselves, must in a crystal be rational, since the symbols of the planes involve only rational numbers. This is a result of the greatest importance, as limiting the kinds of symmetry that are possible in crystals, as will be hereafter seen.

Another important result of this great principle—a principle which, in fact, is only another way of stating the fundamental crystallographic law—is, that we are hereby enabled to deduce relations of great practical value between the angular inclinations and the symbols of four tantozonal planes; the expressions relating to three planes only in a zone not being capable of affording this result.

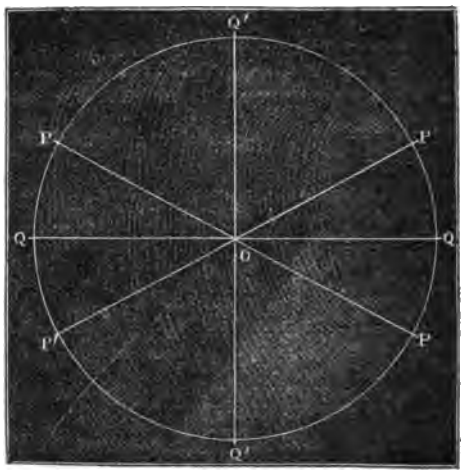
From what was said at the opening of this lecture, it now becomes clear, as an illustration of this point, that if one plane in a zone is equally inclined on two other planes in it (Fig. 6), a plane perpendicular to the first must be a possible plane of the zone, since the normals of the four planes form a harmonic sheaf of lines, and *vice versa*.

Proceeding to discuss the conditions requisite for three successive angles between the planes of a crystal zone being equal, Mr. Maskelyne showed that we come to an expression that limits the values of this angle ϕ to such in which cos. ϕ is rational, and this can be further shown to be true only in cases where ϕ has one of the four values, 90°, 45°, 60°, or 30°.

Future lectures, which will deal with the subject of crystal symmetry and the actual forms and systems that crystals may present, will be mainly concerned with the results that flow from this important principle, which has thus been arrived at by a series of steps established, or in some cases only asserted to be capable of proof, in preceding lectures.

Even to those who, from unfamiliarity with solid geometry, may not have made good these successive links in

Fig. 6.



a continuous chain of reasoning, will at least have become accustomed to the ideas and the terms expressing them which even the exoteric crystallographer has to make his own; and with this preparation we can enter at once on the subject of crystal symmetry.

(To be continued.)

ON THE

COMPOSITION OF THE FATTY MATTER OF WOOL.

By E. SCHULZE and A. URICH.

In a former communication, one of us has shown that, along with free cholesterin, compound ethers of cholesterin and of isocholesterin are found in the grease of wool. The question as to the composition of wool-fat could not be fully solved with the data which we formerly obtained. From the elementary composition of the crude mixture of the wool-grease alcohols, it appeared that, in addition to cholesterin and isocholesterin, another alcohol, poorer in carbon (or a number of such) must be present. We have, therefore, examined two fresh kinds of wool-grease. The one, which we shall designate as *b*, was obtained from the raw wool of North German sheep, by extraction with ether; the other, *c*, was obtained in the same manner from the raw wool of a Swiss mountain sheep. From that portion of both samples which was readily soluble in alcohol it was easy to separate pure cholesterin, and it was proved that this compound was chiefly present in the free condition. The portion of *b* not readily soluble in alcohol yielded, when decomposed with alcoholic potash along with potash soaps, a mixture of wool-fat alcohols, resembling the product obtained from the wool-grease formerly examined. Along with cholesterin was found isocholesterin, apparently in equal quantity. It was separated from cholesterin by the method which we previously employed.

Isocholesterin was also found in *c*, but in a relatively small proportion. When, therefore, the mixture of wool-grease alcohols which separated from the sparingly soluble portion of the sample had been dissolved in an excess of spirits of wine, at first only cholesterin crystallised out of the solution on cooling, without an admixture of isocholesterin. The latter was subsequently deposited from the mother-liquor. Our attention was mainly concentrated

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upon obtaining the alcohols poorer in carbon. From the results of our previous researches, it seemed that this substance was only present in wool-grease in a small quantity, for it had not been possible to obtain, from the mixture of benzoic ethers, besides benzoic cholesterin-ether and benzoic isocholesterin ether, a third compound in quantity sufficient for examination. A third kind of ether, however, might escape observation if soluble in spirit of wine, even though present in larger quantity. We have, therefore, when continuing our researches, converted a part of the wool-grease alcohols (from the sparingly soluble portion of *b*) into benzoic ethers by prolonged fusion with anhydrous benzoic acid. In this case it may be safely inferred that none of the alcohols remain uncombined. The resulting mass was freed by proper treatment from the excess of anhydrous benzoic acid and from the hydrous benzoic acid which had been formed. The residue then contained all the wool-grease alcohols in combination with benzoic acid. Of this residue, about 20 per cent was soluble in hot spirit of wine. The solution deposited oily drops which, even when perfectly cold, remained soft and amorphous. They consisted of a benzoic ether, differing widely in its properties from the benzoic ethers of cholesterin and isocholesterin. From these two compounds it can be separated with tolerable completeness by extraction with cold aceton.

On decomposition with alcoholic potash, this compound yielded, along with benzoate of potash, an alcohol which readily dissolved in ether, aceton, and spirit of wine, but did not crystallise from any of these solvents. It melts at a gentle heat, and cannot be distilled without decomposition. A substance of quite similar properties was also obtained from the portion of wool-grease readily soluble in alcohol. It contained 80·14 per cent of carbon, and 12·29 per cent of hydrogen.

Three alcohols can, therefore, be isolated from wool-grease—cholesterin, isocholesterin, and an amorphous alcohol. The properties of the last-mentioned body afford no certainty that it is a definite chemical compound. It may consist of a mixture of several alkaloid bodies. Among the acids separated from the wool-grease, oleic acid seemed present in considerable quantity, but it was not obtained in a state of purity. The quantity of the fatty acids was not sufficient for complete decomposition by the method of fractionated precipitation; however, the presence was proved of a fatty acid with a very high equivalent, perhaps identical with the hyaenic acid of Carius.

One hundred parts of the above-named portion of the wool-grease, *b*, yielded 53·1 parts of wool-grease alcohols. This number is in favour of the supposition that the sparingly soluble portion of this wool-grease only consists of compound ethers. For 100 parts of a mixture (in equivalent proportions) of oleic cholesterin ether, stearic cholesterin ether, and the corresponding isocholesterin compounds, would yield, on decomposition, 58·8 parts of cholesterin+isocholesterin. 100 parts of the analogous oleic and hyaenic compounds would produce 52·5 parts of cholesterin+isocholesterin. The presence of the amorphous alcohol in the mixture would not make much difference in the quantity of alcohol obtained on decomposition, since, judging from the composition of its benzoic ether, it combines with as much acid as does cholesterin.

With the sparingly soluble portion of the grease *c* the case was different. 100 parts yielded 47·1 parts of wool-grease alcohols. This quantity is not sufficient to saturate the acids present. A portion of the latter must, therefore, be present in a free condition, and, in fact, that alcoholic extract of this grease has a strongly acid reaction. As was formerly mentioned, on the decomposition of the sparingly soluble portion of the wool-grease earlier examined alcohols and acids were found in such proportions that the presence of free fatty acids was suspected. But this assumption could only be regarded as doubtful, since the question still remained why these free acids were not removed by treatment with spirit of wine. This can now be explained, since it has been shown that in wool-grease there occur fatty acids of high equivalents and sparingly soluble.

The bulk of wool-grease, therefore, consists of compound ethers, but a part of the alcohols (cholesterin, at least), and occasionally of the fatty acids, are in a free condition.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 15, 1874.

EDWARD SCHUNCK, PH.D., F.R.S., &c., President, in the Chair.

MR. JOSEPH CARRICK and Professor Morrison Watson, M.D., were elected Ordinary Members of the Society.

"*Analysis of one of the Trefriw Mineral Waters*," by THOMAS CARNELLEY, B.Sc. Communicated by Professor H. E. ROSCOE, F.R.S., &c.

An analysis of this strongly ferruginous mineral water has not, so far as the author has been able to learn, been published before any scientific Society; and though two general analyses of it have previously been made, the first by Mr. D. Waldie, in 1844, and the second by Dr. Hassall in 1871, and published in the form of pamphlets for public reading by Dr. Roberts and Dr. Hayward respectively, yet as it is peculiar for the extremely large quantity of iron and alumina that it contains, and as its composition has varied considerably since it was analysed by the last named chemist (whose results also varied from those of the first), it is thought that another and more complete analysis will not be out of place.

The village of Trefriw is situated on the left bank of the Conway about 2½ miles from Llanrwst and between the latter place and Conway. The springs, which now belong to a company and are often visited by invalids, as they are said to be good for the cure of diseases of the digestive organs and of the skin, are close to the high road which runs between Conway and Llanrwst, and are rather over a mile from the village. The entrance to them is a short way up the side of the mountain called the Alt cae Coch, and consists of an underground passage cut in the rock. There are at present two springs (formerly there were three), one opposite and close to the entrance, the other at the end of a gallery 10 or 12 yards long to the right. The former water is used to supply the baths, and the latter exclusively for drinking; they differ considerably in the relative proportions of their mineral constituents, but it is only the last named which is the subject of this paper.

The water, which flows into a basin cut in the rock, is said to be uniform in quantity and issues at the rate of about 40 gallons per hour; its temperature varies only within very narrow limits and is quite cold. As it occurs in the spring it is perfectly clear, bright, and colourless; but after a short exposure to the air it turns yellow and deposits flakes of ferric oxide; it has no smell, but possesses a strong and very disagreeable inky taste. On being shaken up in a closed bottle no disengagement of gas takes place; it has a strongly acid reaction, and contains neither free carbonic acid, carbonates, nor sulphides; and when first taken from the spring is perfectly free from ferric salts.

The following (I.) is the analysis made of the water collected by the author on September 8th, 1874, together with that (II.) made by Dr. Hassall in the early part of September, 1871,* or just three years previously.

Temperature of the external air	15·5° C.
" " air at the spring ..	12·5° C.
" " water	11·0° C.

* See "Guide to Trefriw and Vale of Conway Spa," by Dr. W Hayward, M.D., M.R.C.S. Second edition.

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	I.	II.
Specific gravity at 17° C. ..	1·00716	1·00570
	Parts per 1,000,000.	
Loss on ignition	7217·5	—
Precipitate formed on boiling one hour	32·8	—
Iron	1507·0	2009·4
Aluminium	233·3	112·4
Calcium	271·3	116·5
Magnesium	134·1	45·4
Potassium	31·5	—
Sodium	25·1	15·3
Manganese	trace	trace
Lead	0·86	—
Ammonium (NH_4)	1·63	—
Albumenoid ammonia	0·34	—
Silica (SiO_2)	157·0	149·0
Sulphuric acid (SO_4)	4985·3	4512·0
Chlorine	11·8	10·9
Nitric acid (NO_3)	9·1	—
Phosphoric acid (PO_4)	2·45	—
Total solid contents	7370·78	6970·9
The residue dried at 310° C..	7370·00	—

The following table represents the above in combination :—

	I.	II.
Ferrous sulphate	4090·4	5454·3
Aluminium sulphate	1358·9	700·7
Calcium sulphate	922·3	376·0
Magnesium sulphate	670·3	225·7
Potassium sulphate	70·3	—
Sodium sulphate	49·9	47·0
Lead sulphate	1·25	—
Calcium chloride	—	16·8
Sodium chloride	19·4	—
Sodium nitrate	4·8	—
Ammonium nitrate	7·2	—
Aluminium phosphate	3·2	—
Manganese	trace	trace
Silica	157·0	149·0
Albumenoid ammonia	0·34	—
Bases for which there is not sufficient acid	15·5	1·4 Loss
	7370·79	6970·9

With reference to this analysis the following observations are to be made :—

(1). The determination of the total residue was first made at 180° C., as recommended by Fresenius,* and the result obtained corresponded to 8100 parts per 1,000,000 ; it was found however that this was much too high, the reason being that ferrous sulphate, though it loses six molecules of water at 114° C., yet retains the seventh even at 280°†. In order to drive off this remaining molecule, the residue from 100 c.c. of water was heated in an air bath to 300°—310° and weighed ; after repeated heating two successive weighings did not differ by more than a milligramme. In heating to so high a temperature, however, there is a danger of a little sulphuric acid volatilising by decomposition of the sulphate of iron, but by careful heating this may be avoided ; a loss of ammonia will, nevertheless, have been incurred, but as this, together with the trace of organic matter, did not amount to more than 8 to 10 parts per 1,000,000, it was not of very much consequence.

(2). It will be seen from the table showing the supposed combination of the salts, that the total bases formed were rather more than sufficient to combine with the acids, and the base which is given above as uncombined is alumina, as it is thought that the quantity of this body obtained was rather too high, for, in addition to the total bases being too large for the total acids, the sum of the oxides ($Fe_2O_3+Al_2O_3+P_2O_5$) calculated from the Fe, Al, and P_2O_5, each estimated directly, is rather greater than the result obtained by weighing the three oxides together, the numbers being 2592 and 2570 respectively—difference 22.

(3). In the determination of the alumina it was separated from the iron by means of tartaric acid and sulphide of ammonium, and weighed as $Al_2O_3+P_2O_5$; the difference between this and the determined amount of P_2O_5 gave the quantity of alumina.

(4). The phosphoric acid was estimated by precipitating with ammonium molybdate, and as the amount was only small, by weighing the precipitate obtained on a constant filter; the calculation was then made from the composition of the precipitate, which contains, according to various authorities, 3·142 per cent. P_2O_5.

(5). The iron was determined directly at the spring with potassium permanganate, and afterwards gravimetrically in the laboratory. The results obtained agreed very nearly.

(6). Several determinations were made of the alkalies, but rather varying results, comparatively, could only be obtained for the sodium. The above is the mean of four, of which the highest was 32 and the lowest 22 parts per 1,000,000, the reason being that the quantity of sodium present was only very small, so that the traces of it also contained in the reagents had an appreciable effect, though they were as pure as could be obtained. The results got for the potassium, however, agreed very nearly.

(7). The lead was determined by the method given in Wanklyn and Chapman's "Water Analysis," as were also the ammonium, albumenoid ammonia, and nitric acid.

By a comparison of the above two analyses it is evident that between September, 1871, and September, 1874, the composition of the water has varied considerably, and though the author has not had an opportunity of seeing the analysis made in 1844 by Waldie, yet from Dr. Hassall's report, given in the above-mentioned pamphlet, it would seem that the results there given also vary much from those obtained by Waldie. The quantity of iron appears to have greatly diminished, while, with the exception of SiO_2 and chlorine, that of the other constituents occuring in larger quantities has considerably increased. A determination of the iron made last February gave 1575·4 parts per 1,000,000, though in this case the determination was not made till after the water had been collected some days. From this it would seem that the iron is gradually diminishing in quantity. The result, however, obtained by Waldie is very nearly the same as that got by Hassall.

From the analysis it will be seen that the Trefriw water is peculiar, as already mentioned, on account of the large quantity of sulphate of iron which it holds in solution ; there being, so far as the author has been able to learn, no spring in the United Kingdom, and perhaps not even on the Continent, which contains it in anything approaching to the same amount, while there are only a few springs known which contain it even in a notable quantity, the analyses of which have been described. The water is also remarkable for the large quantity of sulphate of alumina and silicic acid which are dissolved in it, while the phosphoric and nitric acids, though existing only in small amounts, are rather large compared with what is found in most other mineral waters ; on the other hand, the proportion of chlorine is only small.

The other Trefriw mineral spring was not analysed, but from Dr. Hassall's analysis of the two waters, it appears to contain less iron and alumina, but a larger quantity of alkalies and alkaline earths than the one which is the subject of this memoir.

With regard to the geological position of Trefriw, and the source of the mineral impregnation of the springs, it may be observed that the mountains at the base of which the wells are situated consist chiefly of beds of limestone, ironstone, alum slate, and iron pyrites, together with varying proportions of silicates, very much fractured and dis-

* Fresenius, "Quantitative Analysis." 4th Edition, p. 560.
† Watts, "Dictionary of Chemistry," vol. v., p. 597.

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located, forming the northern extremity of the Bala or Caradoc beds. Up in the mountains and on these beds lie some small lakes from which the springs are supposed to derive their principal supply of water, which, after percolating through the above beds and dissolving large quantities of their constituents, finds its exit near the base of the mountain Alt cae Coch, where it issues from the slate bed (Black Band), and between it and the ironstone. From the above data the composition of the water is easily accounted for. There are several pyrites mines in the vicinity, one of which is situated just over the springs, but much further up the mountain side.

The author has been indebted for Dr. Hassall's analysis and some of his remarks relative to the geological position of the springs to the pamphlet of Dr. Hayward previously mentioned.

NOTICES OF BOOKS.

The Testing of Artificial Colours.

Die Chemische Prufung der kunstlichen organischen Farbstoffe. Von Dr. Ferd. Springmühl. Leipzig: Weigel.

Dr. Springmühl, the editor of the *Musterzeitung* lays before the scientific and technological public, in this pamphlet, an account of the incidental impurities and intentional sophistications occurring in artificial colouring matters, and directions for their detection. Natural organic dyes are to be considered in a future treatise. We may mention as a somewhat disappointing circumstance, that while the introduction leads us to expect some mention of the colouring matters of uric acid and of the alkaloids, they are omitted in the body of the work. As regards picric acid the author finds that oxalic acid is not merely present in many samples as an incidental by-product, but is sometimes intentionally added to the extent of 20 per cent. Samples of phenyl-brown are sometimes largely adulterated with sawdust and fragments of lignite (brown-coal). Oxalic acid and dinitrophenol are also present.

The poisonous properties ascribed to corallin, and to goods dyed with this colour naturally called for the author's attention. He pronounces pure corallin not more poisonous than the remaining phenyl-colours, but finds that it may contain aniline, iodine, mercuric chloride and especially carbolic acid, to which latter he ascribes a great part of the toxic phenomena observed in the case of this dye. For the detection of carbolic acid in corallin he recommends Landolt's test. The sample is dissolved in water, held up to the light and mixed with bromine water. If carbolic acid is present a precipitate or turbidity of tribromphenol appears. Aniline, however, if present, is thrown down at the same time.

In his general remarks on the aniline colours the author informs us that:—French qualities are the most frequently adulterated, whether by the manufacturers themselves or by middlemen. English samples, as far as I have had the opportunity of observing, are distinguished by great purity and excellence."

Out of 25 specimens of magenta one only was found free from arsenic. In 14 the amount was sufficient for quantitative determination. In four samples the proportions were respectively 6·5, 5·9, 5·9, and 5·1 per cent. Such qualities, of course, must prove dangerous if used for colouring liqueurs, confectionery, and toys. In dyeing, however, the amount of the poisonous matter which attaches itself to the wool is relatively trifling. This the author ascertained by an interesting experiment. In a beaker he dissolved 0·1 gramme of the most poisonous sample in hot water. The solution, of course, contained 0·0065 gramme of arsenic. In it a square foot of pure wool (woollen tissue) was dyed. It was then well rinsed in a second beaker of pure water, and again in a third. The dyed wool, the residual dye, and the two wash-waters therefore contained 0·0065 of arsenic, and it remained to ascertain its distribution. In the dye-bath were found 0·0051 gramme, in the first washing-water 0·0010. In the second washing-water the amount was too small to be determined. It, however, and the dyed wool must together contain the residue 0·0005. According to Marsh's test the wool appeared to contain less than the second washing water. Hence a square inch of the woollen could contain scarcely two millionths of a gramme of arsenic. If the proportion of arsenic is low, as in well-purified magentas, the wool, when dyed gives no indications by Marsh's process. It is of some importance to know of what salt of rosanilin a commercial magenta consists, as the proportion of base varies, the muriate being richer than the acetate.

The mercurial process for the manufacture of magenta is still used in some establishments. The author found the crystals of such samples smaller than those of arsenical magentas. Two of the specimens examined contained arsenic, which renders their origin doubtful. In none was mercury detected.

The two most frequent adulterants are oxalic acid and sugar. The author has found 21 per cent of the former, and 24 per cent of the latter. Joly has detected sugar to the extent of 50 per cent.

Aniline violets are more liable to sophistication than magentas from the fact that they are sold, not in well-defined crystals, but in powder or in cakes. The author has detected gum in a Hofmann's violet to the amount of 12 per cent, and 8 per cent of finely ground charcoal in a common phenyl violet.

Aniline blues are treated very briefly. The author does not specify any adulterations as having actually occurred in his investigations, but he recommends consumers to have an eye to the possible presence of sugar.

Of 32 samples of iodine-green examined, 5 were unquestionably sophisticated. One contained 18 per cent of sugar. An English sample was cleverly sophisticated with a salt of lead, probably the picrate, and deflagrated when a portion was heated upon platinum foil. Metallic lead was found to the extent of 10 per cent, corresponding to 21 per cent of the picrate. Two other samples contained respectively 14 per cent. of common salt and 26 per cent of magnesia. Oxide of chrome is also a possible adulteration.

The finest sample of iodine-green examined was from the manufactory of H. Siegle, in Stuttgart. The author considers that in the production of this beautiful and costly colour the Germans are superior to the English and the French.

We shall probably again return to this book on some future occasion. Meantime we feel bound to call to it the especial attention of such of our readers as are connected with dyeing, calico printing, or the manufacture of colours.

CORRESPONDENCE.

MANUFACTURE OF EXTRACT OF INDIGO.

To the Editor of the Chemical News.

Sir,—I have looked in a great many books for information on the manufacture of extract of indigo, but there is no real practical information on it. I contribute this as a help to the human kind.

To make what is generally called *sour extract of indigo*, mix 5 lbs. of best Bengal indigo in 30 lbs. of strong oil of vitriol. Let it stand five days; then put it in a tub and add 40 gallons of boiling-water to it; then filter while hot through strong felt cloth. The filters are usually made this way:—A frame like a table-top, 8 yards long, 2 yards wide. This frame is divided into four filters. Pieces of wood across are put on the top and made to fit the holes

(the shape of bowls, with small holes perforated in them); then the felt cloth is put on the top, and the liquid is put on the filter and filtered through. The sediment at the top is used to colour pottery moulds; that which runs through is put in a tub, and 40 lbs of common salt added. Digest for six hours; then put on the filters again for four or five days. That which drains through runs away into the sewers; that on the top of the filters is the extract. For these proportions the extract should weigh 80 lbs. This is sour extract of indigo of commerce.

Free Extract.—To make free extract of indigo, put 100 lbs. of the sour extract in a tub, 12 gallons of water as well. Neutralise the acid in the extract with strong soda-ash liquor until it is free from any sour taste; then put on the filters for six days. It should weigh 100 lbs. when it comes off. That is free extract of indigo of commerce. —I am, &c.,

BRADFORD.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherw se expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 24, December 14, 1874.

Determination of the Speed of Light and of the Solar Parallax.—M. A. Cornu.—The author finds the speed of light in a vacuum = 300400 kilometres per second of mean time, the probable error being below the one-millionth part.

Observations on the Reproduction of the Phylloxera of the Vine.—M. Balbiani.—A very lengthy paper; not adapted for abstraction.

The American Species of the Genus Phylloxera.—C. V. Riley.

Method Taken for the Discovery of the Substance most Efficacious for Combatting the Phylloxera at the Viticultural Station of Cognac.—M. Max Cornu.

Experiments made upon Healthy Vines with Poisonous Substances.—M. Baudrimont.

Observations on a Recent Communication by M. Volpicelli on the Electric Influence.—M. E. Blavier.—In the *Comptes Rendus* for November 16 appears a note on electric influence, in which M. Volpicelli cites several experiments, the results of which appear to him opposed to the received theory. The author maintains that the facts in question are perfectly conformable to the theory as established by M. G. Green in 1828, and expounded in the "Theorie Mécanique de la Chaleur" of Briot. Two conductors, placed in connection by means of a metallic wire, assume the same potential or the same tension, and the positive fluid passes from the conductor whose potential is highest to the other. On the other hand, a conductor placed in the neighbourhood of a body positively electrified takes a positive potential. If the latter is connected to an electrometer whose potential has been brought to zero by a momentary communication with the earth, it loses a part of its positive fluid, which passes into the electrometer, and imparts to it a positive potential evinced by the separation of the movable leaves. This is the case of M. Volpicelli's second experiment.

Inconvenience Resulting from the Use of Vessels of Bohemian Glass in Chemical Analysis, and especially in Alkalimetry.—M. P. Truchot.—It is known that glass vessels in which various liquids, and even pure water, are boiled, give up by degrees a small quantity of their substance, silica, potash, soda, and lime. Lavoisier mentioned this reaction in showing that water is not changed into earth by ebullition. In general, the error thus occasioned may be neglected; but this is not the case in alkalimetry, and in the use of boiling-flasks and beakers of Bohemian glass, now commonly employed on account of the ease with which they bear the application of heat. If it is required, for instance, to determine an alkaline carbonate in a liquid, we run into it drop by drop a standard acid until tincture of litmus added turns reddish, and to eliminate the carbonic acid which gives a vinous red to the litmus it is raised to a boil. Vessels of Bohemian glass, otherwise well adapted for this operation, after boiling for a few minutes only, give off alkali enough to restore the blue colour of litmus after saturation. The analysis is the more erroneous the longer the boiling is kept up. This, at least, is what results from the use of glasses brought from Germany, and sold at Nancy in 1873 and 1874. This fact may be shown by boiling in a flask pure water mixed with tincture of red cabbage or syrup of violets slightly reddened by an acid. After boiling for a few minutes the liquid turns green. French glasses, with a base of soda, are not sensibly attacked, and therefore do not offer this inconvenience.

Action of Hydrogen upon Nitrate of Silver.—M. N. Beketoff.—The author concludes from a prolonged series of experiments that pure hydrogen reduces silver, like other metals, from neutral or faintly acid solutions. The negative results of M. Pellet may be explained either from the brief duration of his experiments, or from the too great acidity of his solutions.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 13, September 15, 1874.

On Maltose.—E. Schulze.—The author's experiments confirm the results of O'Sullivan's experiments, according to which maltose differs from grape-sugar, having the formula $C_{12}H_{22}O_{11}$; reducing Fehling's liquid in a smaller proportion than grape-sugar, 65 to 66 parts of which reduce as much suboxide of copper as 100 parts of maltose; and having a much greater rotatory power ($\alpha = 149{\cdot}5°$ to $150{\cdot}6°$).

Formation of Asparagic Acid in the Pancreatic Digestion.—S. Radziejewski and E. Salkowski.—The authors find the formation of this acid fully demonstrated.

Electrolysis of Potassium-Phenylacetate.—T. Slawik.—An examination of the electrolysis of the neutral phenylacetate of potash, of the same salt in alkaline solution, of free aceto-phenylic acid, the oxidation of aceto-phenylic acid in an alkaline solution by means of permanganate of potash, and the action of ozone upon aceto-phenylic acid in an alkaline solution.

Oxidation of Ortho-Toluylic Acid to Phthalic Acid. W. Weith.—The oxidation was effected by means of a mixture of permanganate of potash and hydrate of soda. The yield of phthalic acid was from 85 to 90 per cent of the ortho-toluylic acid employed.

Structure of the Derivatives of Benzol.—E. Wroblevski.

Decomposition of Certain Diazo Compounds by Water.—E. Wroblevski.—Hypothetical papers.

Remarks on the Investigation of Hübner and Griess.—E. Wroblevski.—The author controverts the statement of Hübner and Griess that when a sulpho group is introduced into meta-brom-toluol one acid only is formed.

A Communication.—Rörsch and Fassbender.—The authors point out that a body resembling the alkaloids in its general behaviour with reagents may be developed from the liver in chemico-legal investigations. An experiment made with the recent liver of an ox yielded a body which, both in acid and alkaline solutions, was taken up by ether, and behaved like an alkaloid. Prof. Gunning, in investigating a case of poisoning by "liver-sausage" at Middleburg, obtained a similar body from a healthy boiled liver.

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Great care is therefore requisite in the application of the Stass-Otto method in toxicological examinations.

Simple Preparation of the Colouring Matter of Urine from Hæmatin.—F. Hoppe-Seyler.—Jaffe's urobilin, or Maly's hydro-bilirubin, are identical with a pigment which the author previously obtained by treating an alcoholic solution of hæmatin with a reducing mixture of tin and hydrochloric acid.

Remarks on M. Traube's Communication on the "Behaviour of Alcohol-Yeast in Media free from Oxygen Gas.—Oscar Brefeld.—In a paper read before the Chemical Society at Berlin, June 22, Traube maintains that—"(1) Germs of yeast do not develope themselves in the absence of free oxygen, even in the most favourable media. (2) On the other hand, developed yeast, as Pasteur declares, can increase in suitable media, even in the absence of every trace of free oxygen." On this Brefeld remarks—As yeast germs and developed yeast are one and the same thing, namely, simple yeast cells; as, further, between "development" and "increase" there is no primary physiological distinction, it follows that in his second proposition Traube contradicts what he has laid down in his first.

Aromatic Phosphorus Compounds.—A. Michaelis and C. Mathias.—An examination of phospho-phenylic acid and its derivatives.

Constitution of Sulphurous Ethylic Ether.—A. Michaelis and G. Wagner.—A hypothetical paper.

Constitution of "Chamber Crystals."—A. Michaelis and O. Schumann.—The authors remark that chamber crystals are generally regarded as the nitro compound of sulphuric acid, although this view is not based upon direct experiment. They find that chamber crystals, more correctly known as nitro-sulphonic acid, are mainly decomposed by perchloride of phosphorus in a manner accordant with this view, yielding the corresponding chloro-sulphonic acid.

Compounds of the Urethans with Aldehyds.—C. Bischoff.—The compounds examined are those of cinnamic aldehyd and ethyl-urethan; salicylic acid and urethan; furfurol and urethan; aldehyd and propyl-urethan; oil of bitter almonds and propyl-urethan; and valeral and xanthogenamid.

Improved Apparatus for Fractional Distillation.—J. A. Le Bel and A. Henninger.—Not intelligible without the accompanying illustration.

Remarks on Armstrong and Prevost's Communication on the Behaviour of Nitrophenol Melting at 45° with Bromine and Chlorine.—H. Hübner.—The author considers that Messrs. Armstrong and Prevost have obtained in their experiments a mixture of ortho- and para-brom-phenol.

Certain Derivatives of Phenanthren.—E. Ostermayer. The compounds examined are bromised phenanthrenchinon; dibrom-diphenic acid, $C_{14}H_8Br_2O_4$; and diphenic ethyl-ether.

On Acenaphthylen.—M. Blumenthal.—The author has examined acenaphthylen-bromide and its derivatives.

Preparation of Stilben and Certain of its Compounds.—F. C. Lorenz.—Large quantities of stilben were passed slowly—one drop in ten seconds—over oxide of lead at a dark red-heat in an iron tube. The distillate was partly solid, partly liquid. The former portion consisted chiefly of stilben. The latter portion was stilben along with other hydrocarbons dissolved in unchanged toluol. On distilling off the toluol there remained a semi-solid body, which, when united to the solid distillate, amounted to 18 per cent of the toluol employed. It was obtained perfectly pure by re-crystallisation from alcohol. The accompanying hydrocarbons were diphenyl, phenanthren, anthracen, and certain liquid bodies. Benzyl-toluol and naphthalin were not detected.

Colouring Matters obtained from Aromatic Oxy Compounds and Nitrous Acid.—C. Liebermann.—(*Phenol Colouring Matter.*) 5 grms. of phenol were mixed with an equal volume of concentrated sulphuric acid and well cooled, to prevent the formation of phenol-para-sulphuric acid. The amount of the reagent required (sulphuric acid mixed with 5 per cent nitrite of potash) was 20 grms. This was added, with agitation, in such portions that the temperature rose permanently to 40° to 50° without becoming higher. The solution was at first brown, then a fine blue. The operation, with the quantities indicated, lasted fifteen minutes. At last there was a faint disengagement of gas. On cooling, the solution was poured with constant stirring into a large amount of cold water, filtered, concentrated in a porcelain vessel, and dried in the exsiccator. The substance thus treated can be dried at 130° without undergoing any change. It is a brown powder, readily soluble in alcohol. In alkalies it dissolves with a royal-blue colour. Its composition is $C_{18}H_{15}NO_3$. (*Orcin Colour.*)—10 grms. orcin, 10 grms. sulphuric acid, 40 grms. of the reagent. The solution must become a fine purple red. When poured into an excess of water it yields a pure orange-red precipitate. The alkaline solution is purple with scarlet fluorescence. After washing for several days it is dissolved in alcohol, filtered, and evaporated. It forms a splendid cantharides-like mass. Other colouring matters are obtained at the same time, varying in solubility. (*Thymol Colour.*)—10 grms. thymol in fine powder, 10 grms. sulphuric acid, 40 grms. of the reagent. In this case the reagent must be added immediately after the mixture with sulphuric acid. The solution is first green, and then blue; the disengagement of gas must be avoided. The double volume of sulphuric acid is then added, and the whole allowed to stand for some hours. It is then precipitated by being poured into an excess of water, filtered, and washed perfectly. A violet resinous mass, soluble in alcohol, with a fine violet-red colour.

Xylindein.—C. Liebermann.—Xylindein is a green colouring matter developed from decaying oak, beech, and birch-wood under the pathological influence of *Peziza æruginosa*. It contains—

Carbon	65·48 per cent.
Hydrogen	4·71 ,,
Nitrogen	1·00 ,,

Action of Hydriodic Acid upon Santonic Acid, and on Meta-Santonin.—S. Cannizzaro and Amato.—Meta-santonin is formed from santonic acid by the elimination of water. It is not formed in the period of the first action of hydriodic acid and phosphorus upon santonic acid, but after the lapse of several days.

New Formation of Phthalic Acid.—W. Weith and R. Bindschedler.—In preparing anthrachinon-sulphuric acid, a large quantity of a body was obtained, which sublimed in large colourless needles, and dissolved in boiling water, from which it separated out in shining scales. It proved to be phthalic acid.

Nitrile and Amide of "Hydroxyl-Caprylic Acid," and the Amide of Amido-Caprylic Acid.—E. Erlenmayer and O. Sigel.—The nitrile in question is a colourless oily fluid of peculiar odour, which floats upon water, and dissolves in it very sparingly. It is readily soluble in alcohol and ether. With fuming hydrochloric acid it forms a clear liquid, which, on cooling, congeals to a paste of white, silky, crystalline leaflets. This is the amide.

True Leucic Acid Nitrile, and on the Leucic Acid therein Contained.—E. Erlenmayer and O. Sigel.—The true nitrile, differing essentially from that described by Bopp, is a colourless oil, which floats upon water without dissolving. With ether and alcohol it is miscible in every proportion. At the heat of the water-bath it suffers no change, but at higher temperatures it splits up into hydrocyanic acid and amylic aldehyd.

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Relative Constitution of the Diazo Compounds.—E. Erlenmayer.—A hypothetical paper.

Acrolein Bibromide.—Louis Henry.—The polymerised acrolein bibromide, $[(C_3H_4O)Br_2]^n$, contains 74·04 and 73·70 per cent of bromine, whilst bibromo-propionic acid contains 68·96 per cent.

Certain Japanese Alloys.—S. Kalischer.—

	I.	II.
Gold	4·16	0·12
Silver	0·08	48·93
Copper	95·77	51·10
	100·01	100·15
	III.	IV.
Tin	4·38	4·36
Lead	11·88	12·29
Copper	76·60	76·53
Zinc	6·53	6·58
Iron	0·47	0·33
	99·86	100·09

No. I. is light red; No. II. grey, bordering on silver-white, with a yellowish tint; Nos. III. and IV. resemble brass.

Investigations on the Volume-Constitution of Solid Bodies—H. Schröder.—The author examines the isosterism of the anhydrous sulphates of magnesia, zinc, and copper with anhydrite; that of the corresponding sulphates and seleniates of magnesia, zinc, copper, cobalt, and iron; the isosterism of several anhydrous double potassio-sulphates of the magnesian metals; the equality of the volume-measure of the magnesian anhydrous carbonates and sulphates, and of the anhydrous double potassio-sulphates with sulphate of potash, and the rhombic carbonates and sulphates.

Fluoboracic Acid and its Salts.—A. Basarow.—The author concludes that this acid and its salts do not exist.

Preparation and Properties of Triphenyl-Benzol.—C. Engler and H. E. Berthold.—Triphenyl-benzol is sparingly soluble in aqueous alcohol, more readily in absolute alcohol, ether, sulphide of carbon, and most easily in benzol. It fuses between 169° and 170°.

Certain Derivatives of Aceto-Phenon-Alcohol and other Keton Alcohols.—C. Engler and H. Bethge.—The derivatives examined are brom-ethyl-benzol, chlor-ethyl-benzol, diphenyl-dimethyl-ethan, mono-chlor-butyl-benzol, and diphenyl-mono-chlor-methan.

Methyl-Hexyl-Carbinol.—C. Schorlemmer.—This substance when pure boils at 177° to 178°, the barometric pressure being 755 m.m.

New Chloride of Uranium.—H. E. Roscoe.—The pentachloride of uranium, UCl_5, gave on analysis—

	I.	II.	III.
U	57·24	57·35	57·83
Cl_5	42·43	43·01	41·93
	99·67	100·36	99·76

On Mesitylen.—A. Ladenburg.—Not adapted for abstraction.

New Formation of Ethyl-Nitrolic Acid.—V. Meyer and J. Locher.—The authors have studied the action of hydroxylamin upon dibrom-nitro-ethan.

Action of Bromallyl upon Nitrite of Silver.—R. Schiff.—The author in testing the results of Brackebusch (vii., p. 225) obtained merely negative results.

Synthesis of Aromatic Acids.—V. von Richter.—Not adapted for abstraction.

Analysis of Mineral Waters and Salts from Ciechoienck, Poland.—F. Wreden and A. Fuchs.—A detailed statement of results.

Compound of Sarkosin and Guanidin.—E. Baumann.—If sarkosin is heated with hydrochlorate of guanidin there is obtained a clear fused mass, which dissolves in hot alcohol, and forms fine tabular crystals.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of varnish. Maximilian Zingler, Buckland Crescent, Belsize Park, Middlesex. April 9, 1874.—No. 1239. This Provisional Specification describes dissolving camphor in bisulphide of carbon, mixing the solution with powdered gum copal or other hard gum, and afterwards adding either camphor or methylated spirit, or both. After the materials have been thoroughly agitated until the whole of the gum is dissolved, the process is complete, and the product is a spirit varnish. Oil varnish is produced by dissolving linseed or other drying oil in camphor, or in methylated spirits, or in a mixture of these; and this compound is mixed with the spirit varnish above described. With these spirit and oil varnishes can be mixed other gums or resins.

Improvements in galvanic batteries. Alfred Bennett, telegraph engineer, Lorrimore Road, Walworth, Surrey. April 11, 1874.—No. 1255. The novelty of this invention consists of the use of a solution of hydrate of sodium (caustic soda) or hydrate of potassium (caustic potash) with a positive electrode of zinc, using a diaphragm in which a plate of graphite is packed with pieces of broken graphite, peroxide of manganese, or a mixture of broken graphite and peroxide of manganese for the negative electrode. This is wetted with pure water, or a solution of the same salt as that used with the positive.

Improvements in manufacturing alizarin and isopurpurin out of anthracen. Gustav Auerbach and Theodor Gessert, Elberfeld, Germany. April 13, 1874.—No. 1269. According to this invention anthracen is heated with concentrated sulphuric acid to a high temperature; the product is diluted with water, and is neutralised by an alkaline carbonate or with caustic alkali. The mixture then contains the neutral sulphates of the alkaline bases employed and acid sulphates thereof. The neutral sulphates are removed by filtration or crystallisation, and the acid sulphates are neutralised by a further addition of carbonate of soda or potash. The product neutralised as described is then heated along with caustic soda or potash as long as a bluish or red colour is produced. From this product a precipitate of alizarin and isopurpurin is obtained on the addition of an acid.

Improvements in separating the metal tin from the iron in tin-plate cuttings and scraps, and in obtaining the metals, tin and iron, separate for use; also in the manufacture of sulphate of ammonia, chloride of ammonium, sulphate of iron, and sulphate of zinc. James Stuart, chemist, Church Lane, Limehouse. April 14, 1874.—No. 1276. The invention consists in subjecting tin-plate cuttings and scraps to the action of dilute sulphuric acid and atmospheric air, or to the action of dilute sulphuric acid and nitric acid, or dilute sulphuric acid and nitrous acid or hydrochloric acid, and any of the above combinations or compounds of oxygen and nitrogen, when the tin is separated from the iron and remains in solution, from which it is precipitated in the form of metal by placing in the liquor plates of zinc. The sulphates and chloride above mentioned are obtained in the process as by-products.

NOTES AND QUERIES.

Vanadium in Iron.—Can your readers inform me of a good method of detecting, and quantitatively determining, vanadium in iron and iron ores?—S. P.

Dictionary of Chemistry.—Could you kindly inform me whether there is a dictionary of chemical terms, giving the commercial and scientific names, at a reasonable price?—James Baker.

MEETINGS FOR THE WEEK.

Monday, Jan. 18th.—Medical, 8.
—— London Institution, 5.
—— Society of Arts, 8. (Cantor Lectures.) "Alcohol, its Action and its Use," by Dr. B. W. Richardson, F.R.S.
Tuesday, 19th.—Civil Engineers, 8.
—— Zoological, 8.30.
—— Royal Institution, 3. E. Ray Lankester, M.A., "On the Pedigree of the Animal Kingdom."
—— Society of Arts, 8. Captain Shaw, Chief Officer of the Metropolitan Fire Brigade, "On Appliances for Enabling Persons to Breathe in Dense Smoke or Poisonous Vapours."
Wednesday, 20th.—Meteorological, 7. (Anniversary.)
—— Society of Arts, 8. B. Waterhouse Hawkins, F.G.S., "The Graphic Method of Teaching."
Thursday, 21st.—Royal, 8.30.
—— Royal Society Club, 6.30.
—— Royal Institution, 3. Professor P. M. Duncan, "On the Grander Phenomena of Physical Geography."
Friday, 22nd.—Royal Institution, 8. Weekly Evening Lecture. Sir John Lubbock, Bart., M.P., "Wild Flowers and Insects," 9.
—— Quekett Club, 8.
—— Society of Arts, 8. Indian Section; Opening Address by Sir George Campbell.
Saturday, 23rd.—Royal Institution, 3. Mr. E. Dannreuther, "On Beethoven; with Pianoforte Illustrations."

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THE CHEMICAL NEWS.

VOL. XXXI. No. 791.

ATTRACTION AND REPULSION RESULTING FROM RADIATION.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from page 24.)

44. The pump was now kept at full work for an hour. The gauge did not rise perceptibly; but the metallic hammering increased in sharpness, and I could see that a bubble or two of air had been carried down. On igniting the spiral, I found that the critical point had been passed. The sign had changed, and the action was faint but unmistakable *repulsion*. The pump was still kept going, and an observation was taken from time to time during several hours. The repulsion continued to increase. The tubes of the pump were now washed out with oil of vitriol,† and the working was continued for an hour.

FIG. 4C.

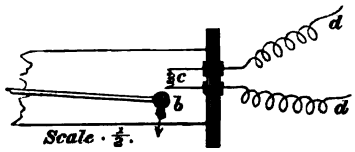
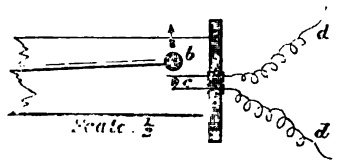


FIG. 4D.



45. The action of the incandescent spiral was now found to be energetically repellent, whether it was placed above or below the brass ball (figs. 4 C, 4 D). The finger exerted a repellent action, as did also a warm glass rod, a spirit-flame, and a piece of hot copper.

46. I now heated the sulphuric acid, in the U-tube desiccator attached to the pump, until it boiled. A little aqueous vapour was driven off; the sharpness of the hammering of the mercury changed to a duller sound; and on trying an experiment once more with the ignited spiral, the action was seen to have returned to one of attraction.

On leaving the pump to itself for an hour or two, the sulphuric acid, as it cooled, again took up the aqueous vapour; and as the absorption proceeded I could trace the action of the hot spiral from attraction, through the point of neutrality, up to decided repulsion.

47. The critical point, in the case of brass balls, is much higher than with pith balls. In the case of pith, applying heat outside, I obtained neutrality when the gauge was about 7 millims. below the barometer, and decided repulsion when there was still a difference of 2 millims. With the apparatus just described, however, using brass balls and an internal source of heat, the critical point is very near the Sprengel vacuum. By close observation I can just distinguish that the gauge is a fraction of a millimetre below the barometer when the hot spiral ceases to exert an attractive action on the brass ball; but my unassisted eye is not able to detect a difference on the gauge between a Sprengel vaccum in which the ignited spiral is neutral to, and one in which it strongly repels, the brass ball.

48. I have experimental grounds for believing that the position of the critical point varies with the density of the mass on which radiation falls, with the relation of its mass to its surface, and with the temperature of the apparatus (62, 63, 64, 65, 67, 75). The temperature of the body used to attract or repel the brass or pith ball also affects the critical point, but it cannot, I think, modify it much; for with the apparatus last described no difference in kind of movement, but only in degree, was noticed, whether the spiral were ignited to full redness, or whether it were merely warmed by a momentary contact of the wires. Further experiments are in progress which may throw light on this point.

49. The very high amount of rarefaction needed before this neutral point is reached, and the change of direction of movement on applying a hot body to one arm of the balance, caused by a difference of exhaustion of a few millimetres on one side or the other of the point of neutrality, are, I think, a sufficient explanation of the anomalous results which were met with in my earlier experiments (2, 19, 20, 21, 22).

50. Although these results were sufficient to show that air-currents could not be the cause of the movements of the balance, I was anxious to decide this point once for all, by a form of experiment which, whilst it would settle the question indisputably, would be likely at the same time to afford information of much interest. Having found that the balance last experimented with had its neutral point close to an ordinary Sprengel vacuum, that the repulsive action only came on by still further pushing the exhaustion, and that, as I further exhausted, the repulsion got stronger, it was of interest to see what would take place in a vacuum so nearly perfect that it would not carry a current from a Ruhmkorff's coil.

In small tubes, and taking certain special precautions, I could prepare a vacuum with my Sprengel pump which would hardly allow an induction-current to traverse it, or would only show a faint, clould-like discharge; but it was impossible to effect this in the large tubes required for these experiments, and, in fact, all the Sprengel vacuum balance-tubes which I had hitherto prepared became brightly luminous when the current from an induction-coil was passed through them. I accordingly fitted up the apparatus shown in figure 5, in which a chemical vacuum could be prepared by a method first devised by Dr. Andrews (*Philosophical Magazine*, February, 1852).

51. *a b* is the tube containing a straw beam with pith ball terminals; at *b* two platinum wires are passed through, to connect with an induction-coil; at *a* the tube is contracted to allow the apparatus to be sealed off; *c* is a portion of the tube containing a copper boat filled with freshly cast sticks of caustic potash; *d* is a tube bent as shown, and nearly full of strong sulphuric acid, which has been previously boiled for some minutes and then allowed to cool in a vacuum; *e* is a mercury joint, connecting the apparatus to the Sprengel pump. At the upper part of the tube *d* is a stopper fitting into a funnel joint and capable of being replaced (as shown in figure) by a tube through which I could pass carbonic acid when desirable. The carbonic acid was prepared by the action of hydrochloric acid on marble; when not being passed into the exhausted tube, the gas was kept bubbling through mercury, where a tube full could be collected from time to time (as shown in the figure) to test with potash. It was found necessary to keep the evolution going on all the

* From the *Philosophical Transactions of the Royal Society of London* vol. clxiv., part 2.

† This can be effected without interfering with the exhaustion. See *Philosophical Transactions*., 1873, vol. clxiii. p. 296.)

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time pretty briskly, to prevent air diffusing in. The joints were made of double caoutchouc tubing, the smaller one tightly wired on and coated with glycerine before the larger tube was slipped over it. The whole was then tightly bound with wire. To prevent air creeping down between the mercury and the glass, glycerine was poured over all the mercury joints, except the one at the top of the mercury fall-tube, which was kept for oil of vitriol, with which the pump was lubricated from time to time.

52. The apparatus being exhausted of air, the balance was adjusted by heating the ends so as to slightly char the one which happened to be the lower. *f* and *g* are two collars of silver foil encircling the tube where the heat is to be applied, and connected with earth by wire. At a very high rarefaction the flame of a spirit-lamp excites so much electrical disturbance in the balance that its adjustment becomes well nigh impossible. This arrangement was adopted in the endeavour to carry off the electricity; it is, however, only partially successful, and the electrification of the balance at the highest rarefactions is still very troublesome.

The air having been removed from the apparatus as perfectly as the Sprengel pump would effect it, carbonic acid was let into the tube by cautiously opening the tap *h*. Exhaustion was again effected, and carbonic acid passed in a second time. This was then pumped out, and the apparatus was filled a third time, This alternate filling with carbonic acid and exhaustion was continued until the gas collected at the bottom of the mercury fall-tube of the pump was entirely absorbed by potash. When this was found to be the case, the exhaustion was allowed to proceed to the highest possible point.* The pump was then stopped; an induction-current now being passed between the wires at the end *b* showed the usual white light of a carbonic-acid vacuum (a trace of red shows atmospheric nitrogen).

The sticks of potash in the copper boat in *c* were then heated to incipient fusion, and the whole was allowed to cool for some hours. The tube was then sealed off by applying a spirit-flame to the contracted part *a*; the potash was then heated again, and the whole was set aside to give the potash time to absorb the residual carbonic acid.

53. By testing from time to time with an induction-coil, the progress of the absorption could be traced; and when the current ceased to pass through the tube, but preferred to strike across in air the full length of the spark, the vacuum was considered nearly perfect. Warming the potash with a spirit-flame, at any time, will cause it to give off sufficient aqueous vapour to allow the spark to pass as a cloud-like luminosity. This will be gradually

FIG. 5.

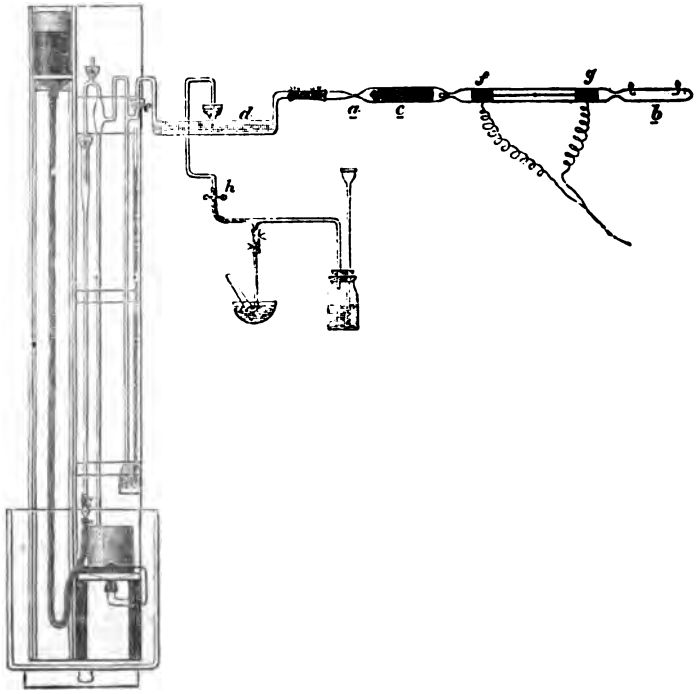
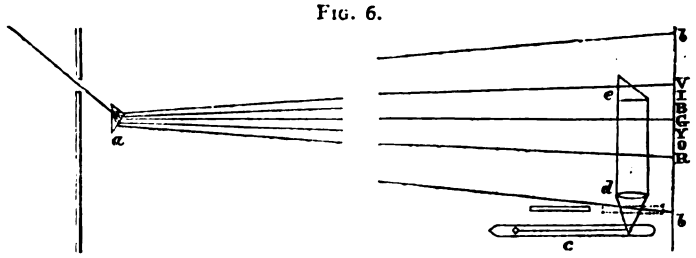


FIG. 6.



* When the pump is working in a very good vacuum, the friction of the falling mercury produces a very beautiful effect in the dark. Brilliant points of light flash about wherever the mercury-drops are splashed from side to side, and the pump is frequently illuminated with a phosphorescent glow filling all the tubes.

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absorbed until, in the course of from a few days to a few weeks, the vacuum will again cease to conduct.

54. It is very difficult to get the vacuum in large tubes so nearly absolute as not to allow a white, cloud-like discharge to pass. I have tried experiments with balances sealed up in vacua of both kinds prepared in this manner, and I always find the repulsion on the approach of a hot body is very decided, although I do not think it is more energetic than with the same kind of balance enclosed in the best Sprengel vacuum I could prepare. These experiments have therefore set at rest the doubts which might have arisen had I only worked with the Sprengel vacua, that air-currents were the cause of the phenomena. They have decided the important point, that in a chemical vacuum which will not carry an induction-current the repulsion by radiation is decided and energetic.

55. Besides the straw and pith balance mentioned above (51, 52), I have prepared and sealed up in chemical vacua balances made of a glass beam and platinum terminals, and also of glass entirely, the ends being flat glass plates. They act in all respects as the straw and pith balance, only being somewhat less sensitive.

56. The delicacy of one of the straw and pith balances in a good vacuum is very great, as may be comprehended by the following experiment:—The balance-tube was supported on a stand, and immediately beneath one of the pith balls was placed the face of a bismuth-antimony thermopile. On connecting the terminal wires of the pile with a single cell-battery, so that the current flowed in one direction, heat was produced, and the pith ball was repelled. On reversing the current, cold was produced and the pith ball was attracted.

57. The rays of the sun allowed to shine on the terminal pith ball of one of these delicate balances *in vacuo* repel it strongly. If concentrated by a lens the focal point beats the ball away, as if it were struck with a material agent. If the sun's light be filtered through coloured glasses before concentrating them on the pith ball, the action is slightly diminished. Passing the light through two very clear plates of alum with parallel sides, and having an aggregate thickness of 8 millims., had but little action.

58. A beam of sunlight was passed through a prism *a* (fig. 6), and the spectrum was projected horizontally on to a screen (*b*) 18 feet off. In front of the screen, a little below it, was arranged the balance-tube *c*, having fixed above it a lens *d*, so that one of the pith balls was in the focus of the lens. A small right-angled prism (*e*) was then held in the different parts of the spectrum, so as to reflect any desired ray on to the lens and concentrate it on to the pith ball. By turning the right-angled prism sideways, the ray could be thrown off and on the ball, and the action readily noted. In the ultra-violet rays the repellent action was slight; the effect increased as I made the reflecting prism traverse the spectrum from the violet to the red. The maximum action was in the extreme visible red, and it gradually faded away as the invisible rays beyond the red were reflected down. An appreciable action of repulsion was, however, observed a full half spectrum in length below the least refrangible visible rays. The plates of alum, interposed in the path of the rays, cut off a small portion only of their action.

(To be continued.)

Peculiar Formation of a Compound of Ethyliden.—F. Baumstark.—On preparing iodethylen by passing ethylen into an alcoholic solution of iodine containing iodine in excess at the temperature of 65°, a peculiar odour was perceived, like oil of mustard. If the decanted mother-liquor was mixed with water, a heavy oil of the same odour was separated. When purified it gave the formula C_4H_9IO, and distilled at 155°.—*Berichte der Deutschen.*

FLUORESCENT RELATIONS OF CHRYSENE AND PYRENE.

By Professor HENRY MORTON, Ph.D.

Being desirous of comparing the fluorescent properties of the later products of coal-tar distillation with those of the "chrysogen" already examined,* I applied to Mr. J. H. C. Cheever, superintendent of the works of Messrs. Page, Kidder, and Fletcher, at Bull's Ferry, and, thanks to his kindness, and to the liberality of the last named gentlemen, who authorised the necessary experiments, I was abundantly supplied with the requisite material.

I should fail to do justice to the scientific zeal manifested by Mr. Cheever, did I omit to relate that several explosions and one melting out of a still were encountered in the course of procuring this supply.

The substances of which I was in search were the chrysene and pyrene, which had been isolated and studied by Messrs. Græbe and Liebermann, and which are described by them in the *Annalen der Chemie und Pharmacie*, 1871, vol. lxxxi., pp. 285, 315.

They describe the material on which they worked as being that obtained by distilling coal-tar to coke, and as being, moreover, a solid of a yellow colour, showing, on fracture, large crystalline plates of a greenish fluorescence.

By treating this with cold carbon-bisulphide, a sulphur-yellow powder was left, which consisted chiefly of chrysene, the pyrene being obtained from the solution.

The material obtained by Mr. Cheever, as already related, differed so much in general character from this description that it was only the confidence that, from the mode of preparation, the pyrene and chrysene must be in it, that inspired me with courage to attempt their extraction. Thus, in the first place, the product, as deposited from the still, had the appearance of a brick-red powder, which, however, on being touched, showed itself to be pre-eminently adhesive, and by pressure, heat, or the action of solvents, settled into a thick tar, which in the property of "stickiness" would without doubt be "*facile princeps*" among all such bodies.

Once introduced into a vessel it was a fixture until removed by a solvent.

A quantity of this raw material being treated with successive portions of carbon-bisulphide, there remained on the filter upon which the residue was thrown, not a yellow powder, but a dark green and still sticky mass. This was introduced into a flask, and treated with successive portions of hot benzol, until only a black residue consisting of carbon and oxide of iron was left.

The benzol solution was filtered hot, and on cooling deposited a dirty-yellow powder.

Two more crystallisations of this from hot benzol brought it to the state of a clear lemon-yellow powder composed of minute crystalline scales, agreeing with the description of chrysene given by Græbe and Liebermann.

The extraction of the pyrene from the material taken up by the cold carbon-bisulphide was, however, a work of far greater difficulty, and its successful accomplishment is entirely due to the unwearied patience and skill of Mr. W. E. Geyer, to whom the preparation of both these substances was entrusted.

A quantity of the solution being introduced into a flask, the carbon-bisulphide was first distilled off as far as practicable on a water-bath, the last portion, however, being only removable by long exposure in a shallow dish. This was carried on in an outhouse, as the combined odour of this solvent and the tar was eminently offensive.

A portion of the resulting semi-fluid tar was then introduced into a flask of about one litre capacity, which was filled full of 95 per cent alcohol, and kept in a water-bath at about 170° F. for some hours. The alcoholic solution so obtained was then poured off and distilled for recovery of the alcohol, and the flask above mentioned was filled

* Chemical News, vol. xxvi., p. 199.

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up with fresh alcohol and heated as before. When this operation had been repeated twice, the alcohol of the subsequent charges was found to deposit on cooling a dirty-green crystalline substance, which was removed by filtration, and by repeated re-crystallisations from hot alcohol, was obtained as a yellow-brown power, corresponding in its properties with the pyrene of Græbe and Liebermann.

A quantity of the tarry residues from which alcohol had been distilled off, as above, was treated with picric acid, and yielded some picrate of pyrene, which was separated by long draining from much fluid tar and further purified by re-crystallisation from alcohol.

This substance, the picrate of pyrene, crystallises very readily in long dark-red needles, which are characteristic in their size and the readiness with which they form in a cooling solution.

They are readily decomposed by dilute ammonia, which combines with the picric acid, setting free the pyrene.

This substance, which was examined subsequently to the chrysene, will be more fully described after the optical properties of the other have been given.

The methods used in the study of the fluorescent and absorption-bands of these substances were exactly the same as have been already described in connection with my similar examination of anthracene, thallene, and the uranium salts (see Chemical News, vol. xxvi., pp. 199, 272; vol. xxviii., p. 47).

Fluorescent Spectrum of Chrysene.

The fluorescence of chrysene in its solid state, when of the bright yellow colour already described, is very strong, resembling in this respect that of chrysogen or of thallene. It is of a vivid yellow-green, and exhibits a spectrum like those of the afore-named bodies, having four blended, broad, bright bands, separated by less bright intervals. The position of these is, however, higher in the spectrum than in chrysogen or thallene, and the upper blue band found in thallene is entirely absent. This last-named point explains exactly the cause of the *yellow*-green colour of its general fluoresence as compared with that of thallene.

It had been already observed by Græbe that the yellow colour of chrysene was due, not to the body itself, but to some associated impurity, and though he was unable to remove this by exposure of the solution to sunlight, as in the case of anthracene, he yet succeeded in procuring a perfectly white chrysene by certain chemical processes, such as the action of a little nitric acid or chromic acid.

In view of the above, the question naturally suggested itself, whether this colouring matter might not be identical with that found in anthracene—in other words, the chrysogen—and, if not, what might be the relation between the two.

To answer this inquiry, it seemed that the only way was to repeat with care the various observations and measurements made upon chrysogen with this yellow chrysene, and then compare the results.

Both the chrysogen found in anthracene and the colouring matter present in chrysene are too small in quantity and difficult of separation to offer any prospect of a direct isolation and chemical study of these substances.

Beginning, then, with the fluorescent spectrum of chrysene, and comparing it with that of chrysogen as found in impure anthracene, we find that both give similar banded spectra, in which the bands are much blended, and are separated, not by dark, but by less bright spaces. The bands, four in number, are in colour blue-green, emerald-green, orange, and red, the division, however, between the red and orange bands being very faint.

The only difference seems to be that in the chrysene the bands are all a little further towards the violet end of the spectrum than in the chrysogen.

The following measurements will further illustrate this:—

	1st.	2nd.	3rd.	4th.
Chrysogen in anthracene	41·3	52·4	68·5	82·3
Chrysene (bright yellow)	41·7	55·0	70·5	85·5

Though this displacement, or rather difference of position, is small, it is distinct and unmistakable, and, in connection with the fact that different specimens of anthracene from different parts of the world, if equally freed from grosser impurities, show no such difference of spectra, seems to indicate a specific difference in the colouring matters, to which these fluorescences are due.

In the next place, the effects of solvents on the fluorescence of chrysene were studied and compared.

Here, as with chrysogen and thallene, it was found that the liquids which dissolved even small quantities acquired a rich fluorescence, and that when this fluorescent light was examined with the spectroscope it showed a banded spectrum, in which the bands were displaced more or less towards the upper end of the spectrum, according to the nature of the solvent.

The following table will exhibit some of the results in this case:—

Spectra of Fluorescent Light Yielded by Solutions of Chrysene.

Bright Band.	1st.	2nd.	3rd.	4th.	5th.
Solid chrysene	41·7	55·0	70·5	85·5	—
Chrysene in chloroform ..	45·6(?)	56·4	72·4	92·0	112·9
,, benzol	46·4(?)	60·3	75·8	92·0	113·7
,, turpentine ..	47·2	62·8	78·4	95·9	116·4
,, ether	50·3	64·6	78·1	97·1	116·(?)

We should here notice that in all the solutions an upper bright band (5th) is seen, which is not found in the solid substance under equal, or even greatly increased, illumination.

When the above measurements are compared with those made some time since on corresponding solutions of impure anthracene, a general and close correspondence is found, both as regards the general effect of the various solvents and the positions of the different lines; without direct comparison, however, it would not be safe to draw more than a general conclusion of similarity from this, as the bands are faint and less defined than in the spectra of the solid substances.

(To be continued).

ON A SIMPLE APPARATUS FOR ESTIMATING UREA.

By RICHARD APJOHN, F.C.S., Prælector of Chemistry in Gonville and Caius College, Cambridge.

A rapid and accurate process for estimating urea is of so much importance in a medical point of view that the recent memoir of Russell and West on the subject (see *Journal of the Chemical Society*, August, 1874), has necessarily attracted much attention. The principle of the method they have employed is the same with that suggested many years ago by Davy, viz., that urea when brought into contact with hypochlorite of calcium is resolved into nitrogen, carbonic anhydride, and water in virtue of the following reaction:—

$$2(CON_2H_4)+3(CaCl_2O_2)=3(CaCl_2)+2(CO_2)+N_4$$

For the hypochlorite of calcium Russell and West have substituted a mixed solution of hypobromite of sodium and caustic soda, which by a like reaction yields similar products, the carbonic anhydride, however, being absorbed by the caustic alkali. Working with the latter solution, I have recently made many experiments which have conducted to the conclusion, that at a given temperature and pressure a given quantity of urea always yields the same volume of nitrogen. Operating with 0·15 grms. of urea, the barometer being at 30, and the thermometer at 60° F. the volume of the nitrogen disengaged and collected over water was found to be 55 c.c., a result almost identical with that obtained by Russell and West.

The apparatus which I have devised for the estimation of the urea is materially different from that employed by Russell and West. It is, I think, more simple, more easily worked, and will give results of at least equal

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accuracy. It also possesses the advantage that the materials for its construction are to be found in every laboratory. They are :—

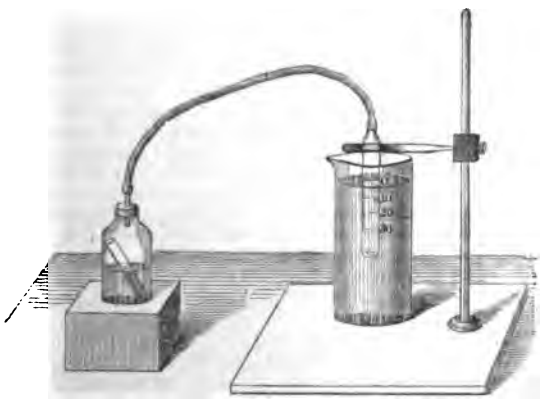
1. A glass measuring tube of about a foot in length, drawn out at the end, which will be uppermost when the tube is used, like a Mohr's burette, and subdivided into 30 parts of equal capacity, the aggregate volume of which is 55 c.c.

2. A small wide-mouthed gas bottle of about 60 c.c. capacity.

3. A short test-tube of about 10 c.c. capacity, and of such height that when introduced into the gas bottle it will stand within it in a slightly inclined position.

The following are the arrangements for combining the apparatus and working an experiment :—

The graduated tube, held in a clamp attached to a retort stand, is depressed into a glass cylinder, nearly filled with water, until the zero mark, which is near the upper end, exactly coincides with the surface of the water. 15 c.c. of the hypobromite solution (100 grms. of NaHO, 250 c.c. of water, 25 c.c. of bromine) having been poured into the flask, the test-tube containing the urine is introduced by means of a forceps, care being taken that none of its contents shall spill into the hypobromite. The flask is now closed with a very accurately fitting india-rubber stopper, perforated with a hole in which is inserted a short piece of glass tubing open at both ends, and is then connected with the measuring tube by means of a piece of elastic tubing. It is now inclined so as to allow the urine to mix with the hypobromite. Effervescence at once commences, and as it proceeds the measuring tube is gradually raised so as to relieve the disengaged nitrogen from the hydrostatic pressure. The flask is shaken a few times, and when the



reaction is completely over, the apparatus is left for a few minutes until it has acquired the temperature of the room in which the experiment is performed. Another exact levelling of the measuring tube is made, and the number of the division corresponding to the volume of the developed nitrogen is read off. Since 55 c.c. correspond to 0·15 grm. of urea, a single division corresponds to—

$$\frac{0{\cdot}15}{30} = 0{\cdot}005 \text{ grm. area.}$$

Consequently, if n is the number of measures of nitrogen obtained in an experiment, $0{\cdot}005 \times n$ will represent the amount of urea present. But as the quantity of urea generally experimented on is 5 c.c., if x be the percentage of urea in the urine, $\frac{x}{20}$ will be the urea in 5 c.c. Hence we have—

$$\frac{x}{20} = 0{\cdot}005 \times n, \text{ and } x = 0{\cdot}1 \times n.$$

It therefore follows that if we operate on 5 c.c. of urine each measure of nitrogen evolved will correspond to 0·1 per cent of urea.

The accompanying rough sketch represents the apparatus just before the flask is inclined so as to bring the urine and the hypobromite solution into contact.

The following results obtained from known quantities of pure urea will give an idea of the accuracy which is attainable by this process :—

C.c. of a 2 p.c. urea solution.	Measures of nitrogen evolved.	Weight of urea taken.	Weight of urea found.
7·4	30·0	0·148	0·150
7·2	28·0	0·144	0·140
6·0	23·8	0·120	0·119
5·0	19·5	0·100	0·097
4·4	17·0	0·088	0·085
4·0	16·0	0·080	0·080
3·0	12·0	0·060	0·060
2·0	8·0	0·040	0·040
1·0	4·0	0·020	0·020

In working with a specimen of urine, three experiments gave on each occasion 3 per cent of urea. In the case of another specimen, in two experiments the percentages of urea were 3·0 and 3·1.

By using a longer and narrower measuring tube, which would admit of finer subdivision, and by making the necessary corrections in the volume of the gas for temperature, pressure, and the tension of aqueous vapour, strictly accurate results could, I have no doubt, be obtained. It should, however, be recollected that the instrument is not intended to yield results of theoretic accuracy, and that in its present form the urea is estimated with sufficient precision for medical purposes.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 14th, 1875.

Professor ODLING, F.R.S., President, in the Chair.

THE visitors having been announced, and the minutes of the preceding meeting read and signed, Messrs. D. Bendix, J. A. Kendall, T. Wiltshire, F. E. Harman, and John Young were formally admitted as Fellows of the Society. The names read for the first time were those of Messrs. H. J. Yeld, H. Shepheard, J. W. Thomas, A. Madge, W. Saise J. Sanders Merry, W. J. Lancaster, and C. C. Connor. There were no Fellows elected at this meeting.

The first paper, "*On the Action of the Organic Acids and their Anhydrides on the Natural Alkaloids*" (Part III.), by G. H. BECKETT and C. R. A. WRIGHT, D.Sc., was read by the latter. The authors find that the action of acetic anhydride on dicodeine and tetracodeine yields tetracetyl-dicodeine, $C_{78}H_{80}(C_2H_3O)_4N_4O_{12}$, and octacetyl-tetracodeine, $C_{144}H_{160}(C_2H_3O)_8N_8O_{24}$. These bases are both amorphous, but the hydrochloride of the former is crystalline, whilst the basic character of the latter is very feeble. Tetramorphine yields, with acetic anhydride, a product resembling that obtained with tetracodeine. The action of acetic acid on anhydrous morphine gives rise to three isomeric diacetyl-morphines, α, β, and γ. The first and last are crystalline, and form crystalline hydrochlorides, whilst the β compound does not. The α diacetyl-morphine is formed only in very small quantity. The authors have submitted the various diacetyl, butyryl, and benzoyl derivatives of codeine and morphine which they have discovered to the action of ethyl-iodide, and find that in each case they unite with $2C_2H_5I$, forming compounds which in many instances are crystalline. The action of sodium ethylate on diacetyl-codeine does not give rise to ethylated codeine, but codeine is reproduced and more or less polymerised to tetracodeine. A similar result was obtained with tetracetyl-morphine.

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The President, in thanking the authors, remarked that the communication opened out several points of considerable interest, such as the influence of particular substances in inducing polymerisation, and the feeble basic characters of the polymerides described, which was in accordance with the general experience that bodies of higher molecular weights exhibit less strongly marked chemical properties.

Dr. Debus asked the author how he knew that the amorphous β diacetyl-morphine was a distinct substance, and not either α or γ diacetyl-morphine, or a mixture of the two rendered uncrystallisable by the presence of colouring matter or other impurity?

Dr. Wright replied that from the known properties of morphine six diacetyl compounds were possible, and that the name β diacetyl-morphine was applied to a certain product obtained in a certain manner. As it was not crystalline, he was, of course, unable to state positively whether it was homogeneous or not.

The next communication was a "*Note on the Effect of Passing the Mixed Vapours of Carbon Bisulphide and Alcohol over Red-Hot Copper*," by Mr. T. Carnelley. The author thought it possible that by this means normal pentane might be formed; but it was found that the products consisted of ethylene, acetylene, methane, hydrogen, and carbon oxysulphide, but that neither sulphuretted hydrogen nor sulphurous anhydride was produced. With the exception of the carbon oxysulphide, therefore, the same result was obtained as when alcohol vapour is passed through a red-hot tube.

Dr. Odling having thanked the author in the name of the Society,

Dr. H. E. Armstrong made a communication "*On the Iodo-Phenols*," being No. XVII. from the laboratory of the London Institution. He finds Busch's statement that iodo-nitrophenol from the non-volatile nitrophenol melts at 154° is not correct; Körner's original description of the compound is, however, accurate. The volatile nitrophenol yields not only two isomeric iodo-nitrophenols when acted on by iodine and mercuric oxide, as Busch states, but at the same time di-iodo-nitrophenol is produced, and a certain amount of the nitrophenol remains unattacked. The author has as yet only isolated Busch's α iodo-nitrophenol in the pure state; it forms orange-red prisms which melt at 109°, and not at 90° to 91°. The potassium derivative crystallises in garnet-red rhombic plates, which become of a brilliant scarlet when rendered anhydrous. According to Busch, it forms red needles. The author has also repeated his experiments on the action of bromine on β dinitrophenol. He finds that, when the latter is heated with bromine and water, he invariably obtains the bromo-dinitrophenol, melting at 116°, but on gently heating the dinitrophenol dissolved in glacial acetic acid, with excess of bromine, in one instance he obtained Körner's bromo-dinitrophenol, melting at 75·5°. In another experiment, where the mixture was heated nearly to its boiling-point for several hours, it gave the compound melting at 116°. It would seem, therefore, that the compound of lower melting-point is capable of undergoing conversion into the isomeride of higher melting-point.

The President said they must all have felt gratified to hear the results of Dr. Armstrong's careful work in differentiating these isomeric bodies, illustrated as it was by such beautiful specimens.

Dr. Debus remarked that he had felt great pleasure in seeing the great care taken in establishing the results which the author had brought before the Society. It was, perhaps, needless to say that the position assumed for the various elements in these substitution compounds was merely provisional. In the two iodo-nitrophenols obtained from the ortho-nitrophenol, the author had placed the iodine in the one case in the position 5, and in the other in the position 4, the NO_2 being 1. He thought it was not sufficiently recognised that this position was merely provisional.

Dr. Armstrong replied that he quite agreed with Dr. Debus that the system was provisional, but it must be remembered that it was an established fact that chlorine, bromine, and iodine behave similarly, at least with regard to the position these elements occupy in the compound. If it be assumed, for instance, that in the volatile nitrophenol the position of the OH and NO_2 groups is 1·2, and that in the non-volatile one it is 1·4, since methods are known by which it is possible to replace the NO_2 by Cl, and thus convert them into chlorophenols, these will likewise be 1·2 and 1·4. If we nitrate para-chlorophenol 1·4, we obtain a chloro-nitrophenol identical with that formed by chlorinating the ortho-nitrophenol 1·2; we conclude, therefore, that in the new substance the groups OH, NO_2, and Cl occupy the positions 1, 2, 4, respectively. In a similar manner, the other derivatives may be traced out.

The meeting was finally adjourned until Thursday, the 4th of February.

NOTICES OF BOOKS.

The Origin of Creation, or the Science of Matter and Force. By T. R. Fraser, M.D., and Andrew Dewar.

In the days of our youth we read Winterl's "Prodromus to the Chemistry of the Nineteenth Century." Like the author himself, we did not perfectly understand the work, but we believe that the "chemistry of the nineteenth century" there foreshadowed must at last have made its appearance in the production of Messrs. Frazer and Dewar. We read here that "atoms are separated into two great classes, viz., mineral and vegetable atoms, or, as they may be called, hydrogen and oxygen. *All atoms are male and female.*" This is surely Winterl's "andronie" and "thelyke" resuscitated. Further, "We find that all animals and vegetables are male and female, and as all animate matter is kept alive by eating or absorbing so-called inanimate matter, for the theory which divides atoms or matter into animate and inanimate is untenable, as we show further on, is it unreasonable to suppose that each inert atom is also either male or female? Besides, the action between the atoms, in order to form any production on earth, is (as we will also find further on) as much a marriage as the intercourse between larger masses of atoms. The mineral atom is the male; and its properties are that it is naturally cold, that it has the blue and white cold colours, and that it is acid and combustible. The vegetable atom is the female; and its properties are, that it is naturally warm, that its colours are yellow, red, and the warm colours, and that it is incombustible" (!).

We should like to know exactly what the authors mean by attributing to atoms sex and the power of reproduction? If such terms are used in the ordinary sense—and if employed in any other, they ought to be carefully explained—they imply organisation, nutrition, secretion, growth, and decay. Two animals, male and female, produce, by their union, a third being *like to themselves*, and continue to exist for a longer or shorter period after its production. Two atoms, on the contrary—say, of oxygen and hydrogen—unite to form a something, *not like, but unlike, themselves*, and become merged in it, resuming, however, their individuality on its destruction. Surely, then, no valid or profitable analogy can be shown between processes so heterogeneous.

The authors' promises to show, "further on," that the distinction between organic and inorganic beings is "untenable," and that the action between atoms is a "marriage," are not kept. We find, in place of proof, mere assertion. We have, further, to object that chemical combination takes place, not merely between those elements which our authors pronounce to be, respectively, male and female, such as oxygen and hydrogen, but also between those which they pronounce to be both males, as mercury and sulphur. It is also, to say the least, not proven that the union of atoms takes place on the dualistic principle, by continued pairing. Many phenomena lead us to believe

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that a compound body may be formed by the simultaneous union of three or four elements. Again, there is the well-known fact that one element may combine with several proportions of another element, forming as many distinct compounds. These phenomena utterly overthrow any imaginary analogy between the reproduction of animals or vegetables and the formation of chemical combinations.

Minerals, we read, have the blue and white cold colours, and are acid and combustible. Let us examine these assertions. Gold, copper, sulphur, and selenium are assuredly neither blue nor white. The sulphides of cadmium, mercury, arsenic, antimony, iron, and copper exhibit those very red and yellow colours which Messrs. Fraser and Dewar pronounce to belong to the vegetable atom. Calcium, barium, potassium, sodium, silicon, and aluminium have the "cold white colour" after they have combined with the "vegetable atom," oxygen, which ought to have given them a yellowish or reddish cast. "The mineral atom" is not necessarily or usually "acid." As a rule, it is only acid after union with the "vegetable atom," oxygen, which, however, uniting with other mineral atoms, forms alkalies and alkaline earths. Perhaps the authors may take exception to what we here put forward as facts fatal to their views. It is, of course, open to them to take this ground. But, if so, they must be able to make good their ground, not by assertion, but by accurate work in the aboratory. Failing this, they cannot even expect a hearing.

On the faith of old and inaccurate experiments, they believe that "plants may be grown in sand, litharge, and even in common shot, merely by moistening them with water." Again, "by a simple experiment we can show that, if these granites or *metals* were pulverised, mixed with vegetable atoms, and seeds were planted in them and well watered, the atoms would show themselves alive by dissolving and aiding in producing a plant, and probably a flower."

We invite the authors, once for all, to try such an experiment, with the necessary precautions to exclude error. Let them sow, say, wheat, in "common lead shot," watering it with distilled water, and taking care that no other kind of matter is introduced in the form of dust or conveyed by the air. Let them finally submit the crop to analysis, and prove that there is an excess of carbon, phosphorus, sulphur, lime, magnesia, potash, &c., over and above what is present in the seed. They can point to no case where such an experiment, conscientiously performed, has proved successful.

The authors deny the presence of moisture in the atmosphere. They say, "if we lay aside a loaf of bread, it will be chemically changed in a few days, and become hard and stale, instead of soft and moist. Scientific works tell us there is moisture in the air, but all experience rather proves to us that there is none (!), for we can keep nothing moist for any length of time. Our bread becomes stale, our wood loses its sap, our gardens thirst for rain, and even our tumbler of water eventually evaporates into air in the atmosphere."

Did the authors, in all the wide and varied experience of which they have thought it necessary to inform the public, never meet with any substances which, when exposed to the air, instead of drying up, became more and more moist? Did they never meet with the case of a shirt, or of bed-linen, though carefully dried, becoming damp by mere exposure to the air? If so, they are as little versed in daily life as in the phenomena of the laboratory. "Our tumbler of water," say the authors, "evaporates into air." By this passage, they apparently mean that it becomes air, for on the previous page we read that the atmosphere is "composed of the same material as the water, only in different proportions." Now, if they are of this opinion, let them prove it correct. Let them demonstrate the presence of nitrogen in pure water, or of hydrogen in air dried and free from ammonia. If they can do this, chemists will be the first to welcome their theories. They cannot, however, speak of hydrogen and nitrogen as identical, for nitrogen is declared to be one of their female, or vegetable elements, while hydrogen is the very type of their male, or mineral class of atoms.

What we have to protest against in this book is not merely the abundance of gross errors, but the total absence of scientific method and of the scientific spirit. Almost every page bears evidence of vague habits of thought, of inaccurate observation, and of hasty generalisation. Of what is required to establish a theory, the authors seem to have but a very dim conception. That such a book should be produced in Britain, and in the latter part of the nineteenth century, is truly humiliating.

Air as Fuel, or Petroleum and other Mineral Oils Utilised by Carburetting Air and rendering it Inflammable. By Owen C. D. Ross, M. Inst. C.E. London: E. and F. N. Spon.

As appears from the title of this work, the author proposes, as a substitute for coal, air rendered inflammable by means of mineral oils. He describes the experiments made by MM. Sainte-Claire Deville and Dieudonné in order to determine the value of petroleum as a source of heat, and the similar trials made at Woolwich in 1866 and 1867. From both these series of experiments it was concluded that, at then existing prices, petroleum could not compete with coal. Since that time, however, the price of petroleum once distilled has fallen from £24 per ton to £9, whilst the crude article at the wells may be had for considerably less. Vast deposits of bitumens have latterly been discovered in many parts of the world, and the probability is that an increased demand will lead to its discovery in other places.

The author lays down the following conclusions as thoroughly established:—"The intrinsic calorific power of such oils for evaporative, or steam purposes, is several times greater than that of coal; the thermal effect, or intensity, of heat obtainable from them in metallurgical operations requiring very intense heat is still more favourable, and allows the efficiency of furnaces requiring such temperatures to be many times multiplied; illuminating gas of very superior quality may be obtained from them at much less cost and with much greater convenience than from coal." Among the advantages of "carburetted air" as fuel may be enumerated its freedom from sulphur, an incalculable benefit in metallurgical operations. The use of a non-sulphurous fuel in our households would do more to purify the air of populous districts than any "smoke consumption Act" can ever effect. On board sea-going steamers, the stock of fuel would require only one-fourth of the space now taken up by coal. "Consequently there would remain available for freight-paying cargo three-fourths of the space now occupied by coal. To many owners of ocean steamers this would be equivalent to an additional net profit at the rate of from £2000 to £2500 per voyage."

Whether the author has succeeded in overcoming all the practical difficulties connected with his project, time and experience must decide; but, in drawing attention to the capabilities of petroleum, he is doing a most meritorious act. The price of coal, which still remains preposterous after the combination of circumstances which led to its rise in 1872 has passed away, is a serious evil to our manufactures, our commerce, and to our health and domestic comfort. Surely it behoves us to examine earnestly and candidly every proposal which may emancipate us from our present bondage to the coal-interests.

Selen-Cyan-Ethylen and Selen-Cyan-Methylen.—Bernhard Proskauer.—The former of these compounds has the formula $C_2H_4(CNSe)_2$. It is very stable, forms fine white needles, insoluble in cold water and ether, sparingly soluble in hot water and cold alcohol. They melt at 128°, and are decomposed to a brown liquid of an unpleasant odour.—*Berichte der Deutschen.*

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CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 25, December 21, 1874.

Moderated Oxidation of the Carbides of Hydrogen: Amylen.—M. Berthelot.—The constitution of organic compounds, *i.e.*, the system of more simple bodies by means of which the former may be produced, and which may in turn be reproduced therefrom, should be studied by having recourse to the most moderate reactions, the lowest temperatures, and the least violent agents. For instance, pure chromic acid should be preferred to bichromate of potash mixed with sulphuric acid, which most chemists employ in studying the constitution of the carbides of hydrogen by way of oxidation, and which they designate by the abridged, but incorrect, name of chromic acid. In fact, true chromic acid gives rise to products less remote from the oxidised body, especially if it is used cold, and in a dilute solution, under which circumstances it gives up merely the fifth part of its oxygen, and becomes chromic chromate, instead of losing the half, and passing into chrome alum. The author has already shown the efficacy of this reagent for changing camphen into camphor, ethylen into aldehyd and acetic acid, acetylen into acetic acid, allylen into oxide of allylen and propionic acid, propylen into aceton and propionic acid. He now extends his researches to amylen derived from amylic alcohol of fermentation, as well as hydride of amylen of the same origin. A mixture of acids was formed in about the following proportions:—

Valerianic acid	36
Butyric acid	16
Propionic acid	17
Acetic acid..	28
Formic acid	3

In the course of his experiments he finds that propionic acid is displaced by all the others; next follows the butyric; valerianic displaces the two former, but it is in turn expelled by the acetic, and this again by the formic. These results, however, are merely approximate, as there is always some partition of the base among the acids employed. The regulated oxidation of propylen yields, as main products, propionic acid and aceton, with a little acetic, formic, and carbonic acids.

Apparatus for the Measurement of Gases in Industrial Analyses, or Gas-Hydrometer.—E. J. Maumène.—Manufacturers of sugar have long wished for a simple, practical, and inexpensive means of rapidly estimating the quality of lime as it comes from the kilns, that is to say, the true degree of its alkaline power at the moment when it is used in the form of milk. The author presents to the Académie a new instrument which he has contrived for this purpose, and to which he gives the name gas-hydrometer, because the gas disengaged in the analyses for which it is adapted is measured by an equal volume of water. It is not a mere calcimeter, or instrument for measuring lime, but at the same time a potassimeter, an acidemeter, &c. The same instrument will serve for the sugar manufacturer to estimate the value of the lime, that of the limestone, that of the scum from carbonating, of the cakes from the filter, that of the acids employed in washing the bone-black, that of the black itself before and after revivification. The essential portion is an india-rubber bottle, fastened by its neck to the end of a copper tube. The other extremity of this tube carries a caoutchouc tube carefully fastened to a copper tube, twice bent, which traverses a caoutchouc stopper serving to close a flask in which the reactions are produced. Suppose, for example, that it is required to assay a limestone: take six fragments at least from the heap, selecting such as appear the most different. These pieces are broken up in an iron mortar till the largest fragments are about the size of a pea. The whole is then passed through a fine sieve. The dust which passes through is taken for analysis. 10 grms. of this are weighed on a balance sensitive to 10 milligrms. This weighed portion is passed into the flask by means of a gutta-percha funnel. The funnel is washed with the amount of water which a tube of hardened caoutchouc, contained therein, will hold. The outside of the tube is then wiped, and filled to 2 centimetres of the mouth with common hydrochloric acid, of specific gravity 1·18 or 1·20. This tube is laid hold of by introducing into it a pair of brass forceps, the two arms of which, diverging at the extremities, lodge their hooks under a ledge in the interior of the tube, and thus permit it to be easily lifted. It is let straight down into the flask, and the forceps are carefully withdrawn without spilling a drop of the acid. A copper cylinder, which encloses the caoutchouc bottle, set in an upright position, is filled with water round about the bottle. It is closed with a stopper of caoutchouc, pierced with two holes, through one of which passes the copper tube above mentioned, and through the other a tube of metal to lead away the water. The flask being then closed with its stopper, the copper cylinder is raised into a horizontal position, and the apparatus is ready for use. The flask is sloped gently to mix the acid with the 10 grms. of stone. A disengagement of carbonic acid gas immediately swells the caoutchouc bottle, and the water surrounding it being displaced flows into a graduated tube, where it is collected. The reading on this tube gives the volume of the gas.

Observations on a Recent Communication by M. A. Cornu on the Degree of Precision of Foucault's Method for Measuring the Speed of Light.—M. J. Lissajous.—A protest against a passage which throws doubt on the exactitude of Foucault's method.

Pyruvic Ureides; Synthesis of Parabanic Acid.—M. E. Grimaux.—Pyruvite is split up by hydrochloric acid into urea and pyruvic mono-ureide, and by nitric acid into nitrate of urea and nitro-pyruvic mono-ureide. This latter compound may, by indirect oxidation, be converted into oxalylurea or parabanic acid.

Molecular Equilibrium of Solutions of Chrome Alum.—M. Lecoq de Boisbaudran.—The author has announced (*Comptes Rendus*, Nov. 9, 1874, p. 1077) that blue solutions of chrome-alum, recently prepared in the cold, acquire gradually a greener shade, and that green solutions of the same alum, recently prepared in heat, gain by degrees a more blue tint; in a word, the two solutions approach slowly to an intermediate colour, which is the proof of the coexistence of the two modifications, in a stable and constant state of equilibrium, for one and the same temperature. These changes of colour are observed whether the liquids are in closed or open vessels, with or without contact of crystals, and whether concentrated or dilute. Still, the changes of colour being very slow, we cannot, by observing them, obtain an exact measure for the progress of the transformation. The author, takes therefore, advantage of the variations in volume which should accompany the change of molecular equilibrium of the salt. On the one hand, the blue alum of the solution made in the cold loses a part of its water of hydration in becoming green. On the other, the green alum of the solution made in heat gains water in becoming blue. In the former case, there ought to be dissociation with change of volume; in the second, the combination should produce a decrease of volume. These previsions are fully confirmed by experience.

Preparation of Pure Salts of Nickel from the Nickel of Commerce.—M. A. Terreil.—Noticed elsewhere.

Toxicological Detection of Cyanide of Potassium in Presence of Double Non-Poisonous Cyanides.—M. E. Jacquemin.—A description of a method for detecting cyanide of potassium accompanied by prussiates.

The author dilutes with water, filters after maceration, neutralises the filtrate with pure carbonate of soda, heats a part to ebullition with 2 or 3 grms. of hyposulphite, then, after cooling, acidulates slightly with hydrochloric acid, and adds perchloride of iron, which gives the characteristic reaction of sulphocyanides.

Action of Chlorine upon Perbromide of Acetylen.—M. E. Bourgoin.—Noticed elsewhere.

Researches on Pathological Albumens, Zymoses, Means of Determining Albumen, and the Alterability of Albumenoid Matters.—M. J. Birot.—Not adapted for abstraction.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 13, September 15, 1874.

Sarcosino-Uric Acid.—A preliminary communication.

Secondary Products from the Preparation of Benzyl-Toluol.—E. Weber and Th. Zincke.—Among these may be mentioned anthracen, and a hydrocarbon, $C_{14}H_{10}$, much more soluble than anthracen.

Further Contributions to the Knowledge of the Polythionic Acids.—W. Spring.—This paper treats of the organic hyposulphurous acids, hyposulphurous acid, trithionic acid, the synthesis and splitting-up of the polythionic acids, and of organic poly-thionic acids.

Action of Perchloride of Phosphorus upon Ethylen-Disulphonic Acid.—W. Kœnigs.—The compounds successively formed are $C_2H_4{}_2(SO_3H)$, $C_2H_4{}_2(SO_2Cl)$, C_2H_4Cl, SO_2Cl, $C_2H_4{}_2Cl$.

Thio-Benzol and Thio-Aniline.—The author has prepared several substitution-products of thio-benzol, taking his point of departure both from phenyl-sulphide and from thio-aniline.

Contributions to the Knowledge of Ethyl-Phenol and Ethyl-Benzol Sulphonic Acids.—P. Chrustchoff.—Solid ethyl-phenol was heated with anhydrous phosphoric acid. Ethylen slowly escapes, and could be converted into bromide of ethylen by absorption in bromine. From the residue a phenol was separated by decomposition with hydrate of potash, which had the boiling-point of common phenol. On account of the smallness of the quantity, it could not be obtained in a state of purity, but with bromine-water it yielded the characteristic tribromphenol; and when boiled with nitric acid of sp. gr. 1·4 it yielded picric acid in abundance; whilst ethyl-phenol, under the same circumstances, yields only oxalic acid.

Mixed Sulphones.—P. Chrustchoff.—A preliminary communication on the synthesis of mixed sulphones.

Contributions to the Knowledge of Mesitylic Oxide and of Phoron.—L. Claisen.—From the author's experiments, the view that mesitylic oxide and phoron are intermediate products in the formation of mesitylen appears untenable.

Two Pathological Colouring Matters in Urine.—F. Baumstark.—The author has obtained two peculiar well-characterised pigments from the urine of a patient suffering from *lepra*. They are the more interesting from their evident relation to hæmatin. Urorubro-hæmatin, $C_{68}H_{94}Fe_2O_{26}$, or hæmatin in which 8H are replaced by $4C+16H_2O$. It is a blue-black, very light mass, with a nut-brown streak, insoluble in water, alcohol, ether, chloroform, and solutions of common salt. Soluble in alkalies and ammonia with a brown-red colour, which takes a very fine garnet-red on dilution, without dichroism. Acids do not give a precipitate, but change the colour to a bluish red. It dissolves in alkaline phosphates and carbonates with a fine magenta shade, and in acidulated alcohol and dilute sulphuric acid with a violet. The spectrum, both of the acid and alkaline solutions, shows little absorption of the violet and blue. In the acid solution there is a narrow band before D and a broad one behind D, closer to each other than in oxyhæmoglobin. On dilution, the narrow band disappears first. In the alkaline solution there is a band to the right of D, one by E, a broad one to the right of F, and one to the right of G, without the blue between the latter being absorbed. All four disappear equally on dilution. *Urofuscohæmatin*, $C_{68}H_{106}N_8O_{26}$, or a hæmatin in which the iron is replaced by hydrogen. Black, pitchy, shining mass insoluble in water, alcohol, ether, chloroform, acids, solutions of common salt, with or without the addition of hydrochloric acid. It dissolves in alkalies, ammonia, alkaline phosphates and carbonates with a brown colour. Its optical behaviour is not characteristic.

Contributions to the Decision of the Question of Position in the Aromatic Group.—R. Fittig and E. Mayer.—Not suitable for abstraction.

Investigations on the Synthetic Formation of Aromatic Compounds by Dehydration.—This interesting series, which is unfortunately too extensive for our columns, consists of a paper by Othmar Zeidler on the compounds of chloral with brom- and chlor-benzol; one by Julius Weiler on the action of methylal upon toluol, benzyl-chloride, and diphenyl; aldehyd and benzol, by Adolf Baeyer; action of chloral and aldehyd upon toluol, by Otto Fisher; on a compound of chloral with thymol, by Emil Jäger; on the compounds of phenol with the aldehyds, by Edm. ter Meer; synthesis of triphenyl-methan and methyl-phenyl-diphenyl-methan, by W. Hemilian; and on fluorescein, and the phthalein of orcin, by E. Fischer.

Occurrence and Composition of Acids in Crude Petroleum.—Carl Hell and Emil Medinger.—A preliminary communication on the presence of acids in Wallachian petroleum.

Action of Nitro-Sulphuric Acid upon Ortho-Nitro-Benzoic Acid.—P. Griess.—In this reaction there are formed four distinct acids, the styphnic acid, and three isomeric dinitro-benzoic acids, two of which are new.

On Iso-Cyan-Phenyl-Chloride.—E. Sell and G. Zierold.—This substance has the formula $C_7H_5NCl_2$. The authors have examined its behaviour with glacial acetic acid, oxide of silver, sulphuretted hydrogen, aniline, water, and alcohol.

Certain Nitro Derivatives of Sulpho-Carbanilid.—A. Brückner.—The author has examined dinitro-carbanilid, dinitro-sulph-urea, and the corresponding mono-nitro substitution-product obtained by heating phenyl-mustard oil with nitranilin.

Action of Sulphuric Acid upon Substituted Anilines.—G. A. Smyth.—The substances examined are the mono-sulph-acid of dimethyl-aniline, that of mono-methyl-aniline, that of mono-ethyl-aniline, and of diethyl-aniline.

Action of Aniline upon the Fulminates.—A. Steiner.—Aniline has a profound effect upon the fulminate of mercury. Metallic mercury is liberated, and there remains a body of the formula $C_7H_8N_2O_2$.

Certain New Nitro-Diphenylamins.—P. Townsend Austen.—An examination of para-pikryl-meta-nitranilin, para-pikryl-para-nitranilin, para-pikryl-meta-pikrylamin, di-para-pikrylamin, para-dinitro-phenyl-meta-nitranilin, para-dinitro-phenyl-para-nitranilin, and barium-di-para-pikryl-diamin.

Behaviour of Methylen-Iodide with Certain Amines.—J. Lermontoff.—The author has examined the action of ethylamin, tri-ethylamin, and aniline upon methylen-iodide.

Phenylen-Oxaminic Acid.—O. Klusemann.—This acid is composed of—

Carbon	53·34
Hydrogen	4·44
Nitrogen	15·56
Oxygen	26·66
	100·00

which agrees with the formula $C_8H_8N_2O_3$.

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Certain Derivatives of *a*-Phenylen-Diamin.—G. A. Barbaglia.—Not suitable for abstraction.

Certain Derivatives of Toluylen-Diamin.—R. Lussy.—This paper treats of toluylen-urethan and toluylen-sulphurea.

Preparation of a Dinitrated Benzanilid, and its Behaviour with Reducing Agents.—M. Mac Hugh.—The author sought to produce a dinitro-benzanilid which should contain a nitro group, both in the benzoyl residue and in the phenyl group.

On Nitro-Cresol.—Paul Wagner.—The author treats of amido-cresol, diazo-cresol, and nitro-cresolic ether.

On Selenbenzamid.—F. von Duchand.—A preliminary communication.

Aromatic Sulphines.—Cæsar Schöller.—The author sought, first, to form dibenzyl-methyl-sulphin-iodide by the action of methyl-iodide upon benzyl-sulphide. The result was a mixture of benzyl-dimethyl-sulphin-iodide and trimethyl-sulphin-iodide. If 2 parts of iodide of methyl and 3 of benzyl-sulphide are boiled, and allowed to stand for two days, there is obtained a reddish brown oily mass, which deposits fine crystals on the sides and bottom. The two sulphines contained may be separated by the fractional precipitation of their chlorides with chloride of platinum.

Certain New Organic Selenium Compounds.—C. Loring Jackson.—The author has obtained dibenzyl-selenide, $(C_7H_7)_2Se_2$; benzyl-selenious acid, C_7H_7SeO,HO; and trimethyl-selenin.

On Sulpho-Cyan-Methylen.—J. Lermontoff.—Two molecules of sulphocyanide of potassium were brought in contact with 1 molecule of methylen-iodide in alcoholic solution, and digested for two to three hours in the water-bath with an upright condenser. The crystals obtained have the composition $C_3H_2N_2S_2$.

Action of Bromine on Acetate of Methyl.—A. Steiner.—The result appears to be hexa- rather than penta-bromaceton.

On Malonic Acid.—C. Osterland.—The author examines methylo-malonic ether, $C_5H_8O_4$; and malonamid, $C_3H_6N_2O_2$.

Certain Derivatives of the Secondary Butylic Alcohol.—S. Reymann.—Not suitable for abstraction.

Colouring Matter Analogous to Magdala Red.—M. T. Lecco.—Reserved for insertion in full.

Ethereal Oil of Lepidium sativum.—A. W. Hofmann.—The oil of *Lepidium* is identical with that of *Tropæolum*, both being the nitrile of phenyl-acetic acid. The former oil boils at 226·5° (corrected 231·5°), the latter at 226° (corrected, at 231·9°).

Reimann's Farber Zeitung, No. 46, 1874.

This number contains fast dyes for knitting-yarns; a black printing colour for woollen goods, which is prepared as follows:—

Extract of logwood at 10° B.	..	1·0 litre.
Black liquor at 10° B.	..	0·2 ,,
Potato starch	..	130 grms.
Calcined starch	..	200 ,,
Blue vitriol	..	30 ,,
Protochloride of iron at 10° B.	..	30 ,,
Extract of indigo	..	70 ,,
Nitrate of iron	..	70 c.c.

There are receipts for a catechu-brown on cotton; for a soap-proof top-blue on vatted cottons and linens; and a fine rose on mixed piece goods and rags.

Preparation of Anthrachinon, $C_{28}H_8O_4$.—The conversion of anthracen into anthrachinon is generally effected by means of bichromate of potash and sulphuric acid. Some manufacturers add a little nitric acid towards the end of the reaction. The anthracen and the bichromate are intimately mixed, and the sulphuric acid, diluted, is added by degrees. On the large scale the operation is performed in vats lined with lead, in which steam is passed. The addition of acetic acid is an improvement. When it is used the proportion of sulphuric acid must be modified. On the small scale the following proportions are recommended:—1 part anthracen is mixed with 2½ parts of bichromate of potash, 4 parts of pyroligneous acid are added, and after heating a time 6 parts of sulphuric acid, previously diluted with double its volume of water, are gradually added. The mixture is heated in the water-bath till the reaction is at an end. The yield is almost equal to what theory requires.

The anthrachinon generally requires to be purified. This is effected by dissolving the crude product in sulphuric acid in cast-iron vessels, and heating until the evolution of sulphurous acid ceases. It is then precipitated with excess of water, collected, well washed, pressed, and dried in a stove at 50°. It is then a greenish-grey impalpable powder.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the furnaces used in the manufacture of alkali and other products. Isaac Shimwell McDougall, of the firm of McDougall Brothers, manufacturing chemists, Manchester and London. April 16, 1874.—No. 1311. This invention is for applying the fuel or heat necessary for the manufacture of alkali, and for the roasting of salt-cake, nitre-cake, sulphate of potash, and other products; and for the finishing of soda-ash immediately under the bed of the furnace, and then through or over the surface of the latter, a method hitherto impracticable except by the gas process, owing to the rapid destruction of the said furnace bed. It consists in forming the fireplace in a chamber situate at one end of the brickwork containing the furnace, the length of the fireplace being crosswise to the breadth of the said furnace. The fire-bars are placed deep enough in this chamber to allow of sufficient room above the same for air to mix freely with the gases of the fuel before passing onward. Extending longitudinally from the upper side portion of the fireplace chamber, and backwards therefrom immediately underneath the furnace, is a flue inclining upwards to the end of the furnace, and divided transversely into a number of smaller upright flues by substantial division-walls, which are built the full length of the furnace bed. The crown of the fireplace chamber is formed of a strong double-ringed brick arch, over which is laid a tile 3 inches thick, forming a portion of the furnace bed. This arch spans from the outside walls of the fireplace chamber (or those walls in proximity to the flues of the decomposing pot) to the top ends of the said division walls, connecting which, to a distance of about 4 feet back from the fireplace chamber, is a series of small one-brick arches. Over these arches are laid tiles 3 inches thick, forming another portion of the furnace bed, the remaining portion of the latter being formed by placing along its entire length a double layer of 3-inch tiles covering the upright spaces or flues between the said division-walls. At the back end of, and resting transversely on, the furnace bed is a bridge wall to prevent the contents of the furnace falling into the flues and fire underneath. The gases formed in the fireplace chamber pass thence through the smaller longitudinal upright flues over the end of the furnace bed and over the bridge wall thereon, through or over the body of the furnace, and coming in contact with the materials therein, are then conveyed by a suitable flue or flues to the condensing towers or chimney in the usual manner.

Improvements in the treatment of wool, hair, feathers, and other similar animal matters, in order to obtain size and other useful products therefrom. Alfred Smith, of Manchester, Lancaster. (Partly a communication from D. Melville, of Christiania, Norway.) April 16, 1874.—No. 1314. In this invention wool, hair, feathers, or fabrics containing such animal matters, are subjected to the combined action of heat, water, and pressure, in a closed kier, until the animal matter is dissolved. Dyes and oil may be recovered from the solution. The solution may be used as a size or as a manure.

Improvements in the construction of self-igniting and inextinguishable danger signal lights for marine and other purposes. Nathaniel John Holmes, of The Hall, Primrose Hill Road, Regent's Park, London, Middlesex. April 17, 1874.—No. 1324. These improvements relate to an improved mode of constructing life buoy or danger signal lights when phosphuretted hydrogen gas or phosphuret of calcium is employed. In one of these improvements I make use of a compound chamber, one chamber being for the reception of the phosphuret of calcium, the other chamber as an air chamber to give buoyancy to the rescue signal when placed in water. The openings at the top and bottom of the rescue signal for the emission of the flame and ingress of the water are closed by metal strips soldered on, which can be removed by tension when the signal is required for use; or in place of the strips, metallic capsules may be employed through which a plug or button is drawn by tension to form the necessary orifices for the flame and water when the rescue signal is required for use. In another improvement I employ a compound chamber, each chamber being fitted with the necessary parts to produce the light. This compound rescue light is employed when great power of flame is required. In another improvement the rescue signal light is constructed so as to be fired as a shell from a mortar or bomb, either with or without attachment to the rocket line apparatus.

THE CHEMICAL NEWS.

Vol. XXXI. No. 792.

ON

ATTRACTION AND REPULSION RESULTING FROM RADIATION.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from page 35.)

59. The following experiments were tried with a very sensitive pith-ball balance sealed up in a good Sprengel vacuum :—

The beam was turned over, so that the centre of gravity was a very little above the centre of suspension ; the balance consequently set on either side. In this condition the ball touching the tube could be made to rise by placing the finger beneath it, the balance then oversetting on the other side. The higher ball could also be made to sink in the same manner by placing the finger on the top of the tube just over it.

60. A piece of glass tube, bent in the form of a spiral (fig. 7), was supported on a stand, so that it could be slipped over one end of the balance tube, which it fitted loosely. Steam was then passed through the glass coil, and a woollen cover was put on it, so that the end of the balance-tube could be kept at 100° C. When the temperature became uniform and steady the pith ball took up a position, as nearly as could be judged, in the axis of the spiral, and then remained stationary. On raising the hot coil, so as to bring the lower part close to the tube, the pith ball rose a little, and on lowering the spiral the pith ball sank.

On applying the warm finger to the cool extremity of the balance-tube, either above or below the pith ball, the latter was repelled by it ; and by employing a lump of ice in the same way in each position the pith ball was attracted. The balance seemed to be as sensitive when one end was heated in this manner as it was when both ends were of the same temperature ; but the rise and fall were not to so great an extent, owing to the controlling action of the hot spiral.

61. The following experiments were tried with a view of ascertaining the conditions of greatest sensitiveness. In all cases the balances were in a good Sprengel vacuum.

A ball of ivory was balanced against a ball of brass on a straw beam ; the ivory was more sensitive to radiation than the brass.

62. A pith ball and one of platinum of the same weight were balanced on a straw beam. The pith was very sensitive, being readily repelled by the finger ; but the platinum was sluggish, and required a spirit-flame to move it.

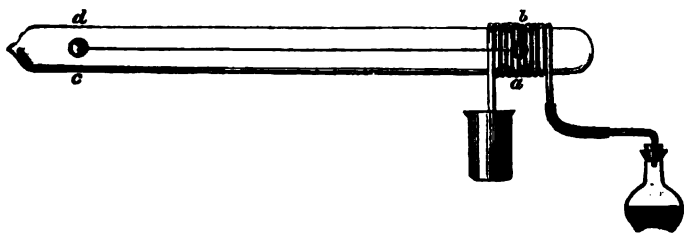
63. Two pith balls of the same weight, one gilt and the other plain, were fixed to the ends of a straw beam ; they appeared equally sensitive to radiation.

Two rectangular blocks of silver and bismuth, each weighing 4¼ grains, were balanced against one another on a straw beam ;* they were each repelled by a warm body applied above or below. The bismuth was a little more sensitive than the silver to the action of heat, but it exposed a little more surface for the rays to impinge upon.

64. A selenium ball was balanced against a copper ball ; the selenium was more sensitive to radiation than the copper ; but I do not think it was more so than would be due to its more extended surface. When I allowed luminous rays, either from the sun or from artificial sources of light, to fall on the selenium, I could detect no special action which I could correlate with the action of light on selenium lately discovered by Mr. Willoughby Smith.†

65. Two pieces of thin mica, each having a surface of half a square centimetre, were fastened to the end of a straw beam, one being horizontal and the other vertical. On applying slight warmth, each end was found to be very sensitive. The horizontal mica was easiest affected by the heat ; but it had not that great advantage over the vertical piece which might have been expected from the much greater surface exposed had the movement been due to air-currents.

Fig. 7.



66. A piece of flat plate-glass, 15 millims. wide and 1·5 millims. thick. was heated in the middle before the blow-pipe till quite soft, and then drawn out till a long ribbon of glass was produced, the width and thickness of which retained the proportions of the original piece. From the middle of this a portion 150 millims. long, 4 millims. wide at the ends, and 3 millims. wide in the centre, was cut off. A double-pointed needle (24) was then secured to the centre by binding with platinum wire and fusing the latter to the glass. This little balance was adjusted until it was very delicate, and was then enclosed in a tube containing potash at one end and platinum wires sealed in at the other end ; it was then arranged, in connection with the Sprengel pump and carbonic acid apparatus, so as to produce a chemical vacuum (51, 52, 53).

When the flame of a spirit-lamp was passed under one end of this balance, the apparatus being full of air at the ordinary density, the result was decided attraction (27, 37, 38, 40, 41). On exhausting and testing from time to time in the same manner,‡ I found the attraction, or rather the sinking of the heated end towards the spirit-flame, to keep at about the same strength until the gauge had risen about 500 millims. After this there was a gradual decline in the downward movement of the glass end of the balance when heat was applied, until the gauge stood about 100 millims. below the barometer. On testing the movement at this pressure I at first thought it was very slight ;

* From the *Philosophical Transactions of the Royal Society of London*, vol. clxiv., part 2.

* These two metals were taken as representing nearly the two extremes of metallic conductors for heat and electricity, and also being the best (silver) and the worst (bismuth) in the list of "vibrators" given by Professor Forbes in his "Experimental Researches regarding certain vibrations which take place between metallic mases having different temperatures" (*Transactions of the Royal Society of Edinburgh*, 1834, vol. xii., pp. 429—461).

† *Telegraphic Journal*, vol. i., p. 78.

‡ It is perhaps scarcely necessary to say that the apparatus was allowed full time to acquire the ordinary temperature of the laboratory between each of these experiments.

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but on keeping the flame of the lamp for about half a minute below the end of the balance the latter commenced to sink, and then the downward movement was almost as great as ever. With a difference of 95 millims. the phenomena were similar, the lamp, however, requiring to be kept under the balance end longer, and the ultimate movement not being so great. At 90 millims. the same thing occurred, the time of heating having to be still longer.

When the gauge was raised to 85 millims. of the barometric height, and the lamp was applied, the first movement was one of repulsion. The glass end rose instantly, but to a very slight extent. On keeping the lamp under for about a minute, the end of the balance slowly came down, until it had sunk a little below its original position.

At 80 millims. difference between gauge and barometer the effect was almost the same as at 85 millims. The preliminary rise was, if anything, a little more marked. For fear of injuring the connections of the apparatus, I did not like to apply the spirit-flame for a longer time than a minute, as the glass then commenced to soften; I therefore, at the higher exhaustions, paid most attention to the initial movement of the glass beam, merely keeping the lamp beneath long enough to see if the continued heating drew the beam down again.

At a difference of 45 millims. between the gauge and the barometer, the neutral point was about reached. The glass beam was not quite motionless on applying the spirit-lamp; it rose very slightly at first, and then descended to the same distance below the original level on continuing the heat.

At 35 millims. the initial rise was immediate and decided. Continued heat only lowered the end a trifle, but did not bring it down to anything near its original position.

From this point the attraction towards the heat ceased to be perceptible. The upward movement increased in strength and amplitude until the Sprengel vacuum was reached.*

At 10 millims. below the barometer the glass beam was repelled by a glass rod or a lump of copper heated to 100° C.; at a difference of 5 millims. between the gauge and the barometer the finger applied below repelled the beam; and at 2 millims. difference the beam was repelled when the finger was applied above.

In the Sprengel vacuum the beam was very sensitive to the approach of a warm body, a touch of the finger sending it away to the fullest extent.

67. I consider that the difference observed between the behaviour of this glass beam, the straw beam with brass ends (37 to 40), and the straw beam with pith ends (30, 31, 32) is to be accounted for by the different materials forming the balances, the different way in which heat was applied in the three cases, and the extent of surface exposed in proportion to mass. There is, however, much to be found out in respect to the position of the critical point, and I am still at work on the subject.

Carbonic acid was then let into the apparatus, and it was re-exhausted. Not wishing to tax the potash too severely, I did not spend much time during this exhaustion; a few observations were, however, taken at different heights of the gauge, and the position of the neutral point was apparently a little raised. The general results were, however, the same as with air. In a carbonic-acid Sprengel vacuum the repulsion by heat was exactly the same as in an air Sprengel vacuum.

68. The remainder of the process for producing a chemical vacuum was then gone through; the tube was set aside till the potash had done its work, and experiments were then tried with it. To the heat of the spirit-lamp, a warm glass or metal rod, the fingers, or the image of a gas-flame concentrated by a lens, the balance was very sensitive, being instantly repelled to a distance varying with the intensity of the heat. Experiments were tried with different rays of the solar spectrum with a similar result to that described in par. 58. The vacuum was so nearly perfect that an induction-spark would not pass, but preferred to strike across its full distance in air.

69. If one of the most sensitive balances (straw and pith (24), or the glass one last described (66)) in a well-exhausted tube is carefully turned on its side, after a little practice the beam can be balanced on one point of the suspending-needle, which will be nearly vertical, In this position the beam has a horizontal movement; and by carefully adjusting the level of the tube the delicacy of the beam can be made very much superior to what it would be suspended in the ordinary way. By bringing a warm body near one end of the balance, it is now driven away to the utmost extent, and a piece of ice attracts it with equally marked energy.

70. On trying this experiment in air of ordinary density, the approach of a hot body causes unmistakable attraction, and a cold body repulsion. In a vacuum this mode of arranging the apparatus did not at first appear to offer advantages over the plan already adopted; but as from the direction of movement it was not likely that air-currents could interfere, or, at all events, not to any great extent, I have arranged apparatus for obtaining the movements of repulsion and attraction in a horizontal instead of a vertical plane, so as to examine the action in air.

Instead of supporting the beams on needle-points, so that they could only move up and down, I suspend them by the centre to a long fibre of cocoon-silk in such a manner that the movements would be in a horizontal plane. With apparatus of this kind, using very varied materials for the index, enclosing them in tubes and bulbs of different sizes, and experimenting in air and gases of different densities up to Sprengel and chemical vacua, I have carried out a large series of experiments, and have obtained results which, whilst they entirely corroborate those already described, carry the investigation some steps further in other directions. I propose shortly to submit an account of this second series of researches to the Society.

71. I have more recently instituted experiments to ascertain how far the action of gravitation in Cavendish's celebrated experiment is likely to be modified under the influence of heat. For many months I have been experimenting with apparatus devised for this purpose. The investigation is not sufficiently advanced to justify further details, but I may perhaps be permitted to give here an outline of one of the results.

72. I find that a heavy metallic mass, when brought near a delicately suspended light ball, attracts or repels it under the following circumstances:—

I. *When the ball is in air of ordinary density.*
   - *a.* If the mass is *colder* than the ball, it *repels* the ball.
   - *b.* If the mass is *hotter* than the ball, it *attracts* the ball.

II. *When the ball is in a vacuum.*
   - *a.* If the mass is *colder* than the ball, it *attracts* the ball.
   - *b.* If the mass is *hotter* than the ball, it *repels* the ball.

73. The density of the medium surrounding the ball, the material of which the ball is made, and a very slight difference between the temperatures of the mass and the ball exert so strong an influence over the attractive and repulsive force, and it has been so difficult for me to eliminate all interfering actions of temperature, electricity, &c., that I have not yet been able to get distinct evidence of an independent force (not being of the nature of heat or light) urging the ball and the mass together.

Experiment has, however, shown me that, whilst the

* In these and many of the other observations accurate measurements were taken of the extent of movement by means of a micrometer-eyepiece, and the time was also accurately noted by a seconds' watch. As, however, the equal and uniform delicacy of the instrument could not be depended upon, I think it best only to give the results in general terms rather than to mislead by an affectation of accuracy not justified by the instrumental means employed.

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action is in one direction in dense air, and in the opposite direction in a vacuum, there is (as I have already pointed out with the balances) an intermediate pressure at which differences of temperature appear to exert little or no interfering action. By experimenting at this critical pressure, and at the same time taking all the precautions which experience shows are necessary, it would seem that such an action as was obtained by Cavendish, Reich, and Baily should be rendered evident.

(To be continued.)

FLUORESCENT RELATIONS OF CHRYSENE AND PYRENE.

By Professor HENRY MORTON, PH.D.

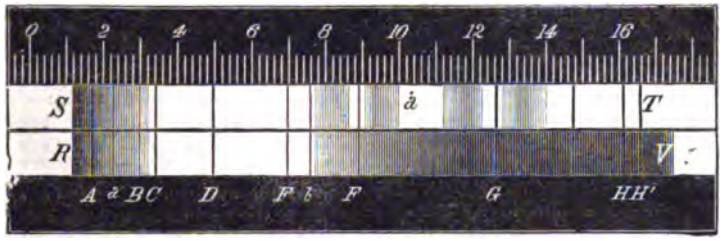
(Continued from page 36).

Maxima and Minima of Fluorescence.

WHEN a pure spectrum is thrown upon a screen coated with solid chrysene, maxima of fluorescence are seen at certain parts, just as is the case with chrysogen and thallene. The accompanying figure will make this clear.

A solar spectrum about an inch broad and 7 inches long is thrown on a paper screen, and the adjustments are made until the principal Fraünhofer lines can be readily distinguished.

FIG. 1.



For the simple paper screen is then substituted one in which the space, S T, is coated with chrysene.

We then have an appearance such as is indicated in the figure.

At R V is seen the ordinary solar spectrum fading gradually away from a bright orange, at D, to an almost invisible violet at V, while above, at S T, where the same light falls on the chrysene, we have the upper part of the spectrum almost as bright as the lower, and of a greenish hue, in which we see, well defined, the Fraünhofer lines, and spaces of special brightness, about F or between 8 and 10 of the scale, at *a* or between 10 and 10·5 of the scale, and about G or between 12 and 12·5, and a portion of yet more vivid green extending from 13 upwards for a distance depending upon the transmitting power of the prism used, for extra violet or actinic rays.

If a strip of paper coated with anthracene rich in chrysogen is placed at R V, the maxima of brightness on this and on the chrysene are seen to correspond in position, but in the case of the chrysogen the spaces between the maxima are much darker than with the chrysene. Otherwise, the action is much alike with these two substances, and in both cases the maxima correspond with absorption-bands which will be described further on. When the same pure spectrum is thrown on the side of a rectangular tank filled with a cold concentrated solution of chrysene in benzol, the appearance presented is that indicated in the accompanying cut (Fig. 2).

Below F, a broad faint illumination of a yellowish green tint reaches far into the tank. A little above* F is a portion of brilliant green, exactly against which comes a blade of darkness, extending, as it were, from the opposite side of the tank, and, in fact, representing the absorption correlative with the maximum of fluorescence which the bright portion represents.

In other words, the actions which the whole phenomenon involves (as was first shown by Stokes in the case of a solution of chlorophyl) are these.

Light vibrations of the particular wave-length which compose this portion of the spectrum are particularly effective in exciting fluorescence in this solution.

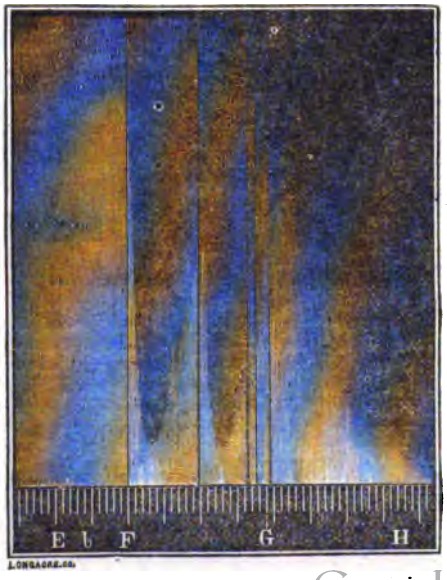
They consequently produce a strong action on the solution as they enter it, but just because their energy is converted into this new form must it be rapidly expended or absorbed. Hence, just these rays which are most active are least able to penetrate into the solution, being used up in producing fluorescent light.

The rays at either side of these, being equally intense, but not so capable of converting their energy into fluorescence, produce less effect, and so travel further into the solution before their power is expended.

Beside the bright spot near F, we find another also of a light green tint below G, with its corresponding blade of absorption, while another bright region begins above G and extends to the limit of the spectrum, being, however, confined more and more closely to the entering surface as it ascends.

The principal Fraünhofer lines are readily seen in this experiment, as indicated in the cut.

FIG. 2.



Compared with a similar solution of anthracene containing chrysogen treated in like manner, the chief difference is, that the maxima and absorption blades are less

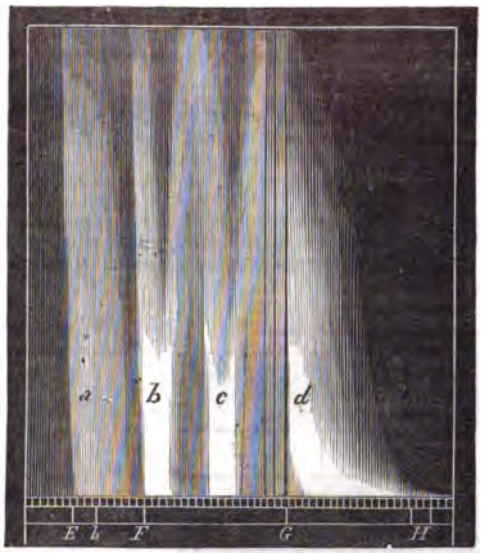
* *I.e.*, to the right of, in cut. Called above because towards the violet or upper end of the spectrum.

sharply defined in the solution of chrysene than in the other substance.

If the solution is diluted, the maxima of fluorescence become less intense, but stretched further into the solution, so pushing back the blades of absorption, and thus giving quite a different general effect, although a careful comparison shows the really close relation of the actions.

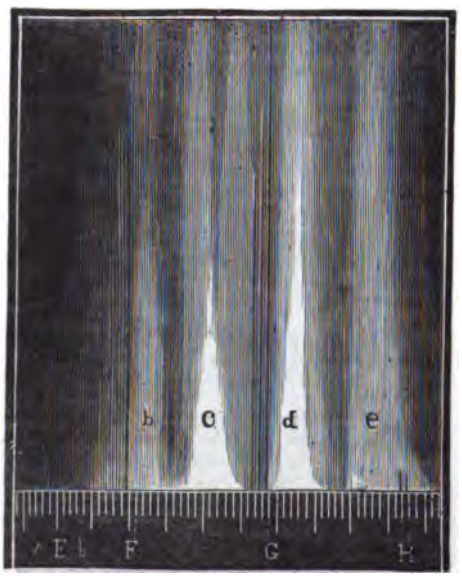
By a yet further dilution the absorption blades may be lost, or, as it were, driven beyond the further side of the tank, and also losing definition by being more gradual and blended.

Fig. 3.



The two accompanying cuts, Figs. 3 and 4, taken in connection with Fig. 2, will sufficiently illustrate this point, though they represent a different substance, *i.e.*, thallene.

Fig. 4.



But, while the colours and exact character of bands differ conspicuously in these materials, their general arrangement and actions are precisely similar.

Fig. 3 shows the effect where a weaker solution is used, causing the exciting rays to reach further and to push back the blades of absorption; and Fig. 4 shows a yet weaker solution.

If we employ a solvent in which the substance is less soluble, just such a change as would result from dilution will be observed, though to this in certain cases may be added other modifications, such as an upward displacement of the maxima, or the disappearance of some of them.

Thus while Fig. 3 represents the appearance seen with a solution of thallene in benzol, Fig. 4 is that given by a solution of the same substance in ether. If, however, the latter drawing were to represent a dilute benzol solution of the same, no change would be required except a slight downward displacement of some bands or maxima.

Effects of Solarisation.

As we have already noticed, Liebermann found that he was not able by exposure to sunlight to remove the yellow colour from chrysene though this method is so effective with anthracene. By greatly intensifying the action, that is to say, by keeping a boiling solution of chrysene in benzol for over thirty minutes in the focus of a lens of 14 inches diameter, we have succeeded in entirely changing the material to which the chrysene owes its yellow colour and brilliant fluorescence as above described. The quantity of solution treated at one time was about two fluid-ounces. On exposing such a hot solution for ten minutes in the focus of the lens, there is deposited a material of a cream colour, which shows a very faint fluorescence compared with that of the ordinary yellow chrysene, and whose spectrum of fluorescence is faint and badly defined, but yet indicates an upward displacement of its bands, as appears from the following table:—

Bright bands.	1st.	2nd.	3rd.	4th.	5th.
Yellow chrysene	41·7	55·0	70·5	85·5	
Chrysene solarised 10′ ..	42·1	56·9	73·5	91·0	108·8

A fifth band also makes its appearance in the solarised material as in the solutions, which is not perceptible in the yellow chrysene.

These changes, it may be remarked, are quite similar to those found in thallene (see Chemical News, vol. xxvi., p. 272), but I have not found any such action where anthracene containing chrysogen is place under similar conditions. In that substance the fluorescence of the coloured constituent is simply destroyed by the action of sunlight on the hot solution without any preliminary displacement of bands.

This displacement of bands by solarisation in solution, taken in connection with the similar displacement by mere solution in certain liquids, gives a hint at that close relation between solution and chemical action which we have also found more definitely indicated in the reactions of uranic double salts in a like connection (see Chemical News, vol. xxviii., p. 47, &c.

Absorption Bands.

If a little yellow chrysene is mixed with melted paraffin and pressed into a thin sheet between two slips of glass, or in any other way reduced to a thin sheet through which light can pass, the transmitted beam will be observed to have certain bands of absorption similar to those seen under like conditions with impure anthracene.

The general absorption of all the upper rays is, however, relatively greater, and thus these bands are the more difficult to recognise and measure.

The various solutions of the same substance, however, shows these bands with great clearness, and their positions are given in the following table:—

Absorption Bands of Chrysene.

Bands.	1st.	2nd.	3rd.
Solid chrysene	89·7	105·3	126·7 ?
Benzol solution	96·3	117·0	
Chloroform solution ..	95·9	116·4	
Ether solution	99·5	121·1	152·8 ?
Turpentine solution ..	97·5	119·6	

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These bands resemble those given by anthracene and by thallene in their general character and in their displacement by a change of solvent, but like the bands of fluorescence seem to occupy positions higher in the spectrum, with the exception, perhaps of the bands of the solid, which hardly appear appreciably different in the case of anthracene and chrysene.

In conclusion, we would observe that from all the phenomena we are of opinion that the substance to which chrysene owes its colouring is not identical with that which gives its tint to ordinary anthracene, and described by Fritsche as chrysogen, but is a distinct though closely analogous substance.

(To be continued).

NOTE. After the above was written we noticed in the CHEMICAL NEWS of August 14th, 1874, the brief description by Dr. Phipson of the new substance chrysenene obtained by him from crude chrysene.

We do not agree with him, however, in thinking it identical with the substance above described, as its fluorescence yields a continuous spectrum in place of the banded one above described. Our experiments, indeed, demonstrate that quite a number of coloured bodies are present in the crude product which are soluble to very different degrees in different solvents, and are thus removed from the chrysene before it reaches the condition in which it was studied as above.

We do not doubt that Dr. Phipson will agree with us in this conclusion after a spectroscopic observation of the fluorescent light emitted by these substances.

This seems indeed to be just one of the cases in which the fluorescent spectrum of a substance is invaluable as a means of discrimination.

A STUDY OF CONDENSATION RADICALS.

By S. E. PHILLIPS.

OF the allotropic peculiarities of the so-called elementary substances we know comparatively nothing; of similar peculiarities in compound bodies we know much, and crave to know more, especially in relation to their volumes and specific heats.

As is becoming for an amateur student, most of my papers are of an enquiring turn, and in this case I write on a subject where ignorance may well be excused.

Mr. Wright has made himself eminent by very extended researches upon morphia and codeia condensations; and the essential enquiry is, why he should regard these bodies, normally or initially, as di-ammonias rather than ammonias, as more generally understood?

As in previous enquiries I have laid stress on some features not accepted by most English chemists, so in this case I must beg indulgence, in mooting that the methods employed by Hofmann, Würtz, Odling, and others, to represent amine condensations are incorrect, and that an extended survey of the field justifies me in maintaining that, if the amine radical be represented by (H_4N), the diamine will not be (H_8N_2), but (H_7N_2), the triamine $(H_{10}N_3)$, the tetra-amine $(H_{13}N_4)$, &c.

While fully ninety-nine out of one hundred analyses necessitate this view, it is not denied that some few exceptional cases, which may be real or apparent, do involve such ratios as H_8N, $H_{12}N_3$, &c. Di-pyridine is a case in point, but for a comparatively extended series the morphia-codeia condensations of Mr. Wright are particularly conspicuous.

If it be worth while to dignify these exceptional cases by a comparison with such as involve almost universality, the task is easy.

The true poly-amines are normally monatomic, and using acetic acid (AcO) in a representative sense, to cover any hydrate, acid, or base, they are—

Amine, $H_4NO+AcO$.
Diamine, H_7N_2O+AcO.
Triamine, $H_{10}N_3O+AcO$.

The exceptional amines are all polyatomic—

Amine, $H_4NO+AcO$.
Diamine, $H_8N_2O_2+2AcO$.
Triamine, $H_{12}N_3O_3+3AcO$.

Wright's tetra-amines would be octamines if, as generally understood, morphia be one N body, and hence the great distinction—

Ordinary Octamine.	Wright.
$H_{25}N_8O+AcO$.	$H_{32}N_8O_8+8AcO$.

In one case we have a condensed radical with a normal saltic type, whether it be an oxy or a chloro salt; in the other case, we have the entire condensation of the whole saltic body *per se*, and the chloride would be Cl_8! In the case of di-pyridine, the constitution depends, perhaps, wholly upon the volumetric point of view entertained.

Most English chemists maintain that chemical considerations should be subordinated to those of vapour density and specific heat, strangely ignoring the fact of their multiple variations; hence they have—

Pyridine	2 vols. H_3N.	Di-pyridine	2 vols. H_6N_2.
Pyridine salts..	$H_4NO+AcO$.	Di-pyridine salts ..	$H_8N_2O_2+2AcO$.

It would, therefore, appear in this case that the condensation takes place first in the radical, or ammonia form, and that O_2, or Cl_2, and 2 of acid are subsequently added!

Per contra, there are those who think that the laws of vapour density and specific heat require much further investigation, and while the facts of multiple variation continue to increase, that chemical considerations should not rashly be laid aside.

Why may we not have ordinary pyridine (2 vols.) and allotropic pyridine (1 vol.)? If certain chemists could but divest themselves of preconceived "idealities," and look the matter fairly in the face, they might possibly find hosts of 1 vol. hydrides and ammonias!

As occupying a lower platform, an outside, independent position between these two aspects, we think it quite possible to devise simple reactions, which should finally determine, *apart from all hypothesis*, whether dipyridine (so-called) have one or two N constituents; in other words, whether it be a condensed allotropic pyridine, a normal di-ammonia, or an exceptional di-salt entering the curious category which is the special subject of this enquiry.

Meanwhile, we pass on to a consideration of the parallel condensations of the simpler hydrocarbons. The general law would seem to be—

2 amines $-2HO$ = a diamine.
2 hydrates $-2HO$ = a condensed hydrate.
2 hydrides $-2H$ = a condensed hydride.

The generality of this law has often been overlooked by chemists, who have abundantly supplied the explanation of what might otherwise appear a deviation from the law.

Both di-hydrides and dihydrates are often represented as of simply a condensed dedoublement of the same atomic weight, it being clearly understood that the 2H or 2HO eliminated in the nascent state have a manifest tendency to combination; but it is not so clearly discriminated that in every such case an alteration of type or series subsists.

As an instance of "polymeric condensation," M. Barbaglia cites the tri-isobutyl-aldehyde, $C_{24}H_{24}O_6=3(C_8H_8O_2)$; or M. Prunier gives the di- and tri-propylenes, (C_6H_6), $(C_{12}C_{12})$, $(C_{18}H_{18})$.

Such cases are very frequent among aldehydic bodies, with their known tendency to assimilate nascent hydrogen, and in some few cases the HO of an alcohol or hydrate is similarly absorbed; but in all cases they are evident departures from the pervading law, and such exceptions give no countenance whatever to the amine anomalies. The resulting di-hydride or di-aldehyde, whether normal or otherwise, in no case being di-atomic!

Propylene is a hydride of the radical (C_6H_5), the radical itself a condensation to 1 vol., the hydride being normally 2 vols.

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Propylene + propylene − 2H = $\left\{\begin{matrix}C_6H_4\\C_6H_5\end{matrix}\right\}$ = $C_{12}H_9,H$ = the true di-propylene.

This body + 2H = $C_{12}H_{11},H$ = the di-propylene of M. Prunier.

A slight digression as to the aldehyde type may, perhaps, be allowed, inasmuch as I am often perplexed as to whether the aldehydes and essential oils may be best regarded as hydrides or weak alcohols.

In the case of M. Barbaglia, it may seem most feasible to prefer the former, and say—

2 butyl-aldehyde, $2(C_8H_7O_2)H - 2H = \left\{\begin{matrix}C_8H_6O_2\\C_8H_6O_2\end{matrix}\right\}$ = $= C_{16}H_{13}O_4,H$,

which, absorbing 2 nascent H in the reaction, becomes $C_{16}H_{15}O_4,H$ as his di-aldehyde; and similarly with the tri-condensation.

If he had, with the enlightened penetration of M. Schiff, wisely gone further, and proved that the di-condensation gave an ammonia, $(C_{16}H_{15}O_4)H_2N$, on the tri-form an amide derivative, $(C_{24}H_{23}O_6)H_2N$, then it would have gone far to justify this aspect; but, pending this, it is certain that an enormous majority of aldehyde reactions are simply conformable to the all-pervading law of—

Hydrate + hydrate − 2HO = the di-compound;

and beyond this, it is noticeable that the simplest and best known alcohols are, in some extreme cases, subject to the same peculiarity.

I have long regarded Dr. Richardson's tribasic ethers as in all probability a great misnomer and mistake; but how to represent the generic reaction, except as above, I know not.

As hydride of glycol, $(C_4H_5O_2)H$, would be isomeric with alcohol, $(C_4H_5)O + HO$, so ethylate of sodium may be represented as $(C_4H_5)O + NaO$ or $(C_4H_5O_2)Na$. If G represent, *pro tem.*, the glycol radical, then we have—

Chloroform, $C_2Cl_3,H + 3GNa = C_2G_3,H$, or $C_{14}H_{15}O_6,H$, and 3NaCl.

In the case of methylic sodium, we have the so-called tri-methylic ether = $C_8H_9O_6,H$, which is isomeric with di-glycol.

Glycol + glycol − 2HO = $\left\{\begin{matrix}C_4H_4O_2\\C_4H_5O_2\end{matrix}\right\}$, or $(C_8H_9O_4)O + HO$.

That the latter would give an amide derivative, $(C_8H_9O_4)H_2N$, is quite certain, and if the former gave $(C_8H_9O_6)H_2N$, the hydride aspect would again be justified.

The issue of this digression has a direct bearing on the proper use of type representations, which may be convenient and even necessary feelers after truth. But, if we could know the actual arrangement of atoms in an alcohol, the probability is that a divine simplicity would be revealed, superseding both types and evincing both expressions under varied conditions.

To resume, it is quite clear and acknowledged that—

2 butyl − 2H = di-butyl, $\left\{\begin{matrix}C_8H_8\\C_8H_9\end{matrix}\right\}$ = $C_{16}H_{17},H$.

2 naphthyl − 2H = di-naphthyl, $\left\{\begin{matrix}C_{20}H_6\\C_{20}H_7\end{matrix}\right\}$ = $C_{40}H_{13},H$.

2 aldehyde − 2HO = di-aldehyde, $\left\{\begin{matrix}C_4H_2\\C_4H_3\end{matrix}\right\}$ = $C_8H_5,O + HO$.

Acetic acid + 3 meth-alcohol − 6HO = trimethyl-acetic acid.

This being an isomer of valerianic acid, and giving the general reactions of that body with certain allotropic differences,—

The chloride in either case is		$(C_{10}H_9O_2)Cl$.
,, salts	,,	,, $(C_{10}H_9O_2)O + MO$.
,, amide	,,	,, $(C_{10}H_9O_2)H_2N$.

These allotropic differences may be well represented in the butyl-alcohols.

Armstrong calls the normal body propyl-carbinol, $(C_6H_7)C_2H_3(O_2H)$. Having halved his diatomic elements; I regard the meaning to be—

Propyl-alcohol + meth-alcohol − 2HO = $\left\{\begin{matrix}C_6H_6\\C_2H_3\end{matrix}\right\}$ = $= C_8H_9,O + HO$.

The iso body is called iso-propyl-carbinol—

$C_2H(C_2H_3)_2.C_2H_2(O_2H)$,

which I regard as—

Meth-alcohol + 3 meth-alcohol − 6HO = $C_8H_9,O + HO$.

The secondary body is called ethyl-methyl-carbinol—

$$C_2H\left\{\begin{matrix}C_4H_5\\C_2H_3,\\OH\end{matrix}\right.$$

which may be—

Alcohol + 2 meth-alcohol − 4HO = $\left\{\begin{matrix}C_4H_3\\C_2H_3\\C_2H_3\end{matrix}\right\}$ = $= C_8H_9,O + HO$.

The tertiary body is called tri-methyl-carbinol—

$$C_2\left\{\begin{matrix}C_2H_3\\C_2H_3\\C_2H_3,\\OH\end{matrix}\right.$$

which I regard as—

Meth-alcohol + 3 meth-alcohol − 6HO = as before.

A difficulty here occurs, as two of these bodies are interpreted to mean the same thing, while one boils at 109°, the other at 82·5°. I then look for the propylic constituents of Nos. 1 and 2; and Armstrong says "only two modifications of propylic alcohol are known, the normal, or ethyl-carbinol, $C_4H_5.C_2H_2.O_2H$, and iso-propylic alcohol, or dimethyl-carbinol, $C_2(C_2H_3)_2H.(O_2H)$." This apparently justifies my interpretation; but of such groups as C_2 or (C_2H_2) I know nothing, nor do I accept such principles of notation.

Omitting the iso body, these may be true representations of allotropic genesis, but the curious thing to notice is, that under varied conditions they are convertible into each other. If from the amide, $(C_8H_9)H_2N$, from No. 1 we reproduce the alcohol, it is found as No. 2, and a repetition of the process yields No. 4. The prevalence of this law is well seen in the infinity of glucoside condensations, where the genius of M. Schiff has been so eminently conspicuous.

Several very extended condensations have been obtained with enanthol, salicylol, benzoic aldehyde, and similar bodies. We only notice two of these:—

Salicylic acid + 7 salicylic acid − 14HO = $= (C_{112}H_{33}O_{32})O + HO$;

7 atoms of the salicyl radical being condensed into 1 of salicylic acid, and if the amide were obtained, there is no question but that it would be $(C_{112}H_{33}O_{32})H_2N$.

The action of enanthol upon urea has given a 12-fold condensation of ammonia. If the hydride be employed, it is, successively, hydride + ammonia − 2H. If enanthol be employed, it is, similarly, hydrate + ammonia − 2HO; and, calling enanthyl $C_{14}H_{13},H = Ae$, we may notate the body called "penta-enanthyl-hexamine," as thus:—

$(CO)_2H\ H_3N_2$	the di-urea.
$(CO)_2AeH_3N_2$	,, tri-urea.
$(CO)_2AeH_3N_2$	,, tetra-urea.
$(CO)_2AeH_3N_2$	,, penta-urea.
$(CO)_2AeH_3N_2$	,, hexa-urea.

Otherwise, $(CO)_{12}Ae_5H_{19}N_{12}$ or $(H_{36}N_{12})$. It is improperly called a hexamine; but how it would behave as such may clearly be seen by the analogous "ethylenic di-urea," $(CO_4)(C_4H_3)H_7N_4$. "It retains the character of a simple atom of ammonia: it is a monacid tetramine;" hence the Pt salt is $(CO)_4(C_4H_3)H_8N_4Cl + PtCl_2$.

Freely interpreting Mr. Wright's very recent papers on morphia and codeia, I would say that his acetyl-morphine is—

Acetic acid + morphia $(C_{34}H_{19}O_6N) - 2HO$ = $\left\{\begin{matrix}C_{34}H_{18}O_6\\C_4H_3O_2\end{matrix}\right\}$ = $C_{38}H_{21}O_8N$.

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2 acetic acid + morphia ($C_{34}H_{19}O_6N$) − 4HO =

$$= \left\{ \begin{matrix} C_{34}H_{17}O_6 \\ C_8H_6O_4 \end{matrix} \right\} = C_{42}H_{23}O_{10}N.$$

Acetic acid + codeia $C_{36}H_{21}O_6N - 2HO$ =

$$= \left\{ \begin{matrix} C_{36}H_{20}O_6 \\ C_4H_3O_2 \end{matrix} \right\} = C_{40}H_{23}O_8N.$$

Butyric acid + codeia $C_{36}H_{21}O_6N - 2HO$ =

$$= \left\{ \begin{matrix} C_{36}H_{20}O_6 \\ C_8H_7O_2 \end{matrix} \right\} = C_{44}H_{27}O_8N.$$

Benzoic acid + codeia − 2Hl =

$$= \left\{ \begin{matrix} C_{36}H_{20}O_6 \\ C_{14}H_5O_2 \end{matrix} \right\} = C_{50}H_{25}O_8N.$$

&c., &c.

And the question again arises, why should all these be doubled, and the chlorides have 2 Cl and the salts 2 atoms of acid?

It is a poor remark to say that most other chemists regard these alkaloids as 1N bodies, because Mr. Wright has made the subject one of special and very extended investigation.

I find in Watts's "Dictionary" the following oxy-morphia derivatives:—

Oxy-morphia,	$C_{34}H_{19}O_8N$.
The chloride,	$C_{34}H_{19}O_8NHCl$.
„ chloro-platinate,	$C_{34}H_{19}O_8NHCl + PtCl_2$.
„ nitrate,	$C_{34}H_{19}O_8NHO + NO_5$.
„ hydrate,	$C_{34}H_{19}O_8NHO$.
„ „	$C_{68}H_{38}O_{16}N_2HO$!

It is a misnomer to call these hydrates, because there is no HO of hydration corresponding with the acid constituents—they are truly oxides of the ammonium of which morphia is the ammonia; and the notable thing to observe is, that the doubled, or di-ammonium, is an illustration of the wide, if not universal, law of diamines we have essayed to enforce.

In contradistinction from these, Dr. Wright's iodides are N_2H_2HI; the di-iodide, N_4H_4HI; the tetra-iodide, N_8H_8HI.

The very great labour, skill, and penetration involved in Dr. Wright's researches demand the very highest respect; and if I have appeared to dwell unduly on a diverse aspect, it is only with the sincere desire to understand peculiarities towards which I can see only the very faintest clue.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Saturday, January 16th, 1875.

Professor J. H. GLADSTONE, F.R.S., President, in the Chair.

THE usual fortnightly meeting was held at the Physical Laboratory, South Kensington. Messrs. W. H. Perkin, F.R.S., C. H. Lemann, and W. Bottomley were elected members.

A paper was read, by the PRESIDENT and A. TRIBE, Esq., "*On the Electrolysis of certain Metallic Chlorides.*" If metallic copper be immersed in solution of cupric chloride, insoluble cuprous chloride is formed upon it. The authors found that, if a strip of platinum be connected with one of copper, and the two immersed, the insoluble cuprous salt was also deposited upon the platinum. Attributing this result to the electrolysis of the cupric salt by a feeble current, they tried the effect of a zinc platinum cell excited by common water, and with platinum electrodes in the cupric chloride (2 to 10 per cent). Cuprous chloride appeared at the negative electrode, and chlorine at the positive. An ordinary Grove's cell also gave cuprous chloride for the first two or three minutes, but afterwards metallic copper. A zinc and a platinum plate were joined, and immersed in cupric chloride; cuprous chloride was deposited upon the platinum, the edges being encrusted with metallic copper. With magnesium in place of zinc, a larger proportion of copper was obtained. Precisely analogous results were obtained, mercurous and ferrous chloride appearing at the negative electrode.

A communication was made by Professor GUTHRIE, "*On Salt Solutions and Attached Water.*" Continuing the direction of research previously indicated, the results of which were communicated to the Society in November last, the author described the following facts:—Contrary to the generally-received opinion, the minimum temperature attainable by mixing ice with a salt is very independent of the ratio of the two, and of their temperature and of the state of division of the ice. The temperature of a mixture of ice and a salt is as constant and precise as the melting-point of ice. The nine salts resulting from the union of potassium, sodium, and ammonium, on the one hand, and chlorine, bromine, and iodine on the other, were examined in reference to their cryo-hydrates, the temperatures of the formation of which range from −28° to −11° C. For the same halogen, sodium salts assume less water than ammonium, and ammonium less than potassium. For the same metal, iodine salts assume less water than bromine, and bromine salts less than chlorine. The result of the examination of thirty-five salts establishes the identity of the temperature at which the cryo-hydrate is formed, with the temperature got by mixing the salt with ice. Only two apparent exceptions to this identity have been as yet observed. The temperature at which a cryo-hydrate is formed is, with these exceptions, lower according as it assumes a less molecular ratio of water. There appear to be no exceptions to the rule that the lower the temperature got by mixing the salt with ice, the lower the molecular ratio of water. The temperature of incipient solidification of spirits of wine of different strengths was also examined. It was found that from spirits containing more water than the 4-molecule hydrate pure ice was separated, and that the temperature gradually sank to −34°, when the ratio of the 4-molecule hydrate was reached; thence the temperature remained constant, and the whole solidified into a hard mass. When a spirit richer than this cryo-hydrate is cooled, the cryo-hydrate separates, and stronger and stronger spirit is left, which ultimately defies the source of cold to solidify it. Professor A. Dupré's experiments regarding the maximum temperature produced on diluting alcohol are thus singularly confirmed, for this experimenter showed that this very 4-molecule ratio produced the greatest heat in its formation. Ethylic ether, which dissolves water and is dissolved by it, seems to form a definite cryo-hydrate. Water saturated with ether solidifies at −2° C., without separation of ether; the icy mass so got, when ignited, burns with a colourless flame, the heat of which just suffices to melt the ice.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 26, December 28, 1874.

This number is taken up with accounts of the prizes awarded by the Académie for researches, and reports of the speeches delivered on the occasion.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 14, October 26, 1874.

Notices towards a Knowledge of Sulph-Urea and Guanidin.—W. Weith.—This paper treats of the action of sulphuretted hydrogen upon carbo-diphenylimid, and upon sulpho-carbanilid; the dissociation α-triphenyl-

uanidin; and the action of bisulphide of carbon upon arbo-diphenylimid.

Various Communications.—V. Meyer.—These consist of researches on the aromatic sulph-acids, by E. Mölling; a paper on the esters of the mercaptans, by W. Michler; and on dibrom-ethan, by V. Meyer.

Communications from the Laboratory of the University of Göttingen.—H. Hübner.—This paper includes a memoir on benzanilid and nitric acid, by C. Stöver; one on isomeric mono-nitro-benzo-naphthylamids, and their various behaviour with hydrogen, by P. Ebell; on benzoyl-amido-phenols, by H. Morse; on nitro-salicylic acids, by L. B. Hall; and on amido-benzo-nitriles, by A. Fricke.

Preliminary Communications.—J. Post.—The author is engaged with the study of the chemical and physical properties of all known nitro derivatives of phenol for the purpose of solving the "questions which at present impel chemical research, namely, the respective position of atoms and groups of atoms in the molecule."

Contribution to the History of the Phenomena of Fermentation.—H. Struve.—A comment on Traube's paper "On the Behaviour of Alcoholic Yeast in Media free from Oxygen Gas" (*Berichte*, No. 11). He complains that the researches undertaken by Döpping and himself—the result of which was put forward by Liebig in his "Chemical Letters" (1865, p. 18)—have been completely overlooked. These experiments on fermentation have never been repeated by Pasteur. He avoided it, as they could not be brought to harmonise with his theory.

The Law of Multiple Deviations.—E. Mulder.—The power of molecular rotation, which certain compounds of carbon possess in solution, can be modified by different agencies. In general, we have to distinguish a stable and an unstable modification of molecular rotation. As an instance of the former we may take tartaric acid. Dextro-tartaric acid can be transformed into uvic acid (a compound of dextro- and lævo-tartaric acid); therefore, dextro-tartaric acid is capable of interversion into the lævo-tartaric. Since uvic acid, as is generally admitted, remains optically indifferent under various agencies which affect the rotation of dextro-tartaric acid, the inference may be drawn that the molecular rotations of dextro- and lævo-tartaric acid, under similar circumstances, are respectively equal and opposite. If we assume with Landolt for the molecular rotation of dextro-tartaric acid,—

$$(M)n = +21{\cdot}08{,}10,$$

then the molecular rotation of lævo-tartaric acid, under similar circumstances, is $(M)n = 21{\cdot}08$. The inversion in question takes place only in accordance with the law of multiple rotations. As to the unstable modification of molecular rotation, there are carbon compounds whose molecular rotation is temporarily modified by certain agencies, and which return to their original rotatory power as soon as these agencies are withdrawn. Thus the molecular rotation of dextro-tartaric acid is temporarily modified by bases. (See Landolt, *Berichte*, vi., p. 1075.) A continued study of these modifications of molecular rotation may be of exceedingly great value in its scientific applications. The author names merely the study of the influence of salts upon salts, of acids upon salts when an optically active base or acid is present, by means of which we are enabled to trace the chemical decomposition quantitatively by means of polarised light.

Anhydrous Phloroglucin.—H. Hlasiwetz.—In the July number of this journal, p. 891, Piccard makes a communication on this body, $C_{12}H_{10}O_5$, and remarks that, to the best of his knowledge, it has not been previously described: the author has described it nine years ago. See *Transactions of the Vienna Academy*, I., II., 2 abth., p. 84.)

Detection of Alkaloids in Dead Bodies.—W. Schwanert.—Already noticed in the Chemical News.

Rauite—a New Mineral from Brewig in Norway.—S. R. Paykull.—The mineral in question occurs in the Island Lamö, near Brewig. It is a blackish grey zeolite of finely granular texture, and must be a metamorphosis of Elaeolite, as it manifestly undergoes transition into the latter mineral. Its composition is—

Silica	39·21
Alumina..	31·79
Ferric oxide	0·57
Lime	5·07
Soda	11·55
Water	11·71
	99·90

It approximates closely to Thomsonite. It is perfectly devoid of lustre, and contains traces of foreign bodies, as horn-blende, &c. Its sp. gr. = 2·48, hardness = 5. It is not met with crystalline.

Bulletin de la Societe Chimique de Paris, No. 11, December 11, 1874.

At the monthly meeting of the Society, November 6, M. Fordos described his experiments on the action of alimentary and medicinal substances upon vessels of plumbiferous tin in presence of air. Wine and vinegar rapidly take up lead in however small proportion it may be present.

MM. Friedel and Guérin announce that they have obtained an oxychloride of titanium. The compound was previously observed by Ebelmen, who took it to be the protochloride. It is produced by passing a current of hydrogen and of tetrachloride of titanium through a tube heated to bright redness, and containing titanic acid. Sesquichloride, Ti_2Cl_6, is formed simultaneously. The oxychloride: it appears in brown rectangular lamellæ, which are red by transmitted light, and under the polarising microscope present the characters of orthorhombic bodies. Its composition is $Ti_2O_2Cl_2$. If treated with ammonia it yields titanic acid, with disengagement of hydrogen, resulting from the oxidation of the sesquioxide of titanium. The titanic acid in the tube is transformed into a crystalline mass of a fine coppery metallic lustre. It is the sesquioxide, Ti_2O_3, and presents exactly the crystalline form of oligistic iron ore from Elba. This identity of form confirms the explanation which M. Friedel has already given of the varying composition of titaniferous irons. They are merely mixtures of isomorphous compounds.

M. Thiercelein explained his process for extracting the iodine contained in phosphate of lime.

M. Schützenberger communicated the first results of a series of experiments on albumenoid bodies. He has studied especially the prolonged action of a boiling solution of baryta upon these compounds, as well as that of dilute boiling sulphuric acid for a limited period. He finds in the first case a notable evolution of ammonia at the outset, but which by degrees ceases entirely. The ammonia evolved represents about one-ninth of the total nitrogen of the albumen in question. There are formed at the same time oxalate and sulphate of baryta. The filtrate, when freed from excess of baryta by a current of carbonic acid, still contains a little baryta in the form of a soluble salt of complex composition. Almost the totality of the albumenoid body is converted into crystalline amidic compounds, such as tyrosin, leucin, and inferior homologues. The disengagement of ammonia during the action of baryta tends to show that one part of the nitrogen, one-ninth at most, is found in the albumen in the form of urea. The following experiment supports this view:—Coagulated albumen, heated for some time with sulphuric acid diluted to the tenth, is split up into two parts almost equal—the one, insoluble in water, but soluble in alkalies (containing C, 53·3, H, 7·2, N, 14·2), the other, soluble in water, and precipitable by mercuric nitrate, is very similar to Mulder's teroxide of protein. The mercurial precipitate, decom-

posed by sulphuretted hydrogen, gives, on evaporation, an amorphous product containing C, 50·01; H, 6·5; N, 14·5. This product, on ebullition with baryta, yields a little ammonia and carbonate of baryta. The ammonia and carbonic acid formed are in a ratio corresponding to that which urea demands.

Amongst the soluble products obtained by the action of sulphuric acid, there is formed a substance presenting the characters of glucose.

M. Gautier added the following observations:—When caustic potash is heated with a little water, and dry albumen is gradually thrown into it, a small quantity of ammonia is evolved if the heat does not exceed 250°. The product, dissolved in water and saturated with sulphuric acid, gives off an insupportable odour of excrements. Alcohol extracts from this product leucin, 12 to 15 per cent in amount; a substance resembling butalanin; and a crystalline matter, which appears to be the same as what Schützenberger has obtained by the action of baryta upon albumen, and which is analogous to leucin, but contains less hydrogen. By heating albumenoid bodies to 100° with pure water he obtained, *e.g.*, with gluten, syntonin, albumen, a variety of crystalline bodies, but neither fatty bodies nor urea. He announced, also, that his assistant, M. Danlos, was engaged with the products of the oxidation of albumen.

M. Gautier is resuming the study of the various proteic matters of the white of egg. He finds that albumen coagulable chiefly at 63° contains 1·7 to 1·8 per cent of sulphur; whilst that coagulating at 73° differs, not merely by its rotatory power, but also by its proportion of sulphur, which does not exceed 1·54 per cent.

M. Bourgoin gave an account of the perbromide of acetylen and its homologues.

M. Petit describes certain experiments on fermentation which completely confirm the existence, in the leaves of fruit trees, of a mixture of reducing and non-reducing sugars. In the leaves of the vine the proportion of non-reducing sugar sometimes reaches two-thirds of the whole quantity. Determinations by Fehling's liquor, confirmed by fermentation-experiments and polarimetric observations before and after inversion, show that this non-reducing sugar is, chiefly at least, cane-sugar.

M. Henninger described M. Van't Hoff's researches on the preparation and properties of cyan-acetic acid.

Coagulation of Albumen.—M. V. Urbain.—The author, on behalf of himself and M. Mathieu, comments on an experiment of M. Gautier, laid before the Society on June 19, which, in the opinion of the latter, militates against the author's theory of the coagulation of albumen by heat. To justify such a conclusion, M. Gautier should have shown that the albumen still coagulable by heat—the result of the treatment which he indicates, no longer contained carbonic acid; this he has not done. The method which he has pursued is, M. Urbain holds, insufficient to remove the carbonic acid.

Contributions to the History of Cyan-Acetic Acid.—M. J. Van't Hoff.—The author took as his point of commencement mono-chlor-acetic ether, and by observing certain conditions, obtained almost the theoretical yield of cyan-acetic acid. It forms crystals, slightly coloured, fusible at 80°, and yielded on analysis 15·9 per cent of nitrogen, whilst the formula CH_2CNCO_2H would require 16·4. It is decomposed at about 165°, giving off carbonic acid, and forming a liquid composed mainly of aceto-nitrile.

Observations on the Rotatory Powers of Camphor, and of certain other Bodies.—J. de Montgolfier.—This important paper does not admit of useful abstraction.

Symbols Employed to Designate the Rotatory Powers.—M. J. Ribau.—The author proposes that determinations made with the monochromatic flame of soda should be designated by the symbols a_d to express the absolute deviations, and $[a]_d$ for the rotatory power, thus recalling their relation with the ray D of Fraünhofer. Observations made with the visible tint should be as usual represented by the symbol $[a]_j$.

Rectification.—M. E. Demole.—The author, referring to his paper on the preparation of glycol (*Berichte der Deutschen*, 1874, p. 641), points out that the alcohol must be used, not at 80, but at 91 per cent.

MISCELLANEOUS.

Gramme's Magneto-Electric Company.—This company has been formed to utilise for industrial purposes Gramme's Magneto-Electric Machine. Amongst the important objects which the promoters have in view are the application of the machine to the production of light, the electro-deposition of metals, and to metallurgy and chemical manufactures. Most successful experimental results have been obtained, and useful as the invention will prove for industrial purposes, it possesses still higher value from a scientific point of view, being based on new principles. The capital of the company is to be £250,000 in 25,000 shares of £10 each, 14,000 of which are now offered for subscription. The share lists will close on Thursday, February 4, for London, and Friday, February 5, for country applications.

Metropolis Gas Supply.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently reported to the Corporation of the City of London, and to the Metropolitan Board of Works, on the quality of the gas supplied by the Chartered, the Imperial, and the South Metropolitan gas companies during the quarter which expired on the 31st of December last. He states that the average illuminating power of the common gas of the Chartered Company at the four testing places was as follows:—At Beckton, North Woolwich, 17·46 standard sperm candles; at Cannon Street, City, 16·68 candles; at Friendly Place, Bow, 17·02 candles; and at Ladbroke Grove, Notting Hill, 16·63 candles. The illuminating power of the gas supplied by the Imperial Company averaged 16·68 candles at Carlyle Square, Chelsea; 15·63 candles at Camden Street, Camden Town; 16·58 candles at Graham Road, Dalston; and 17·36 candles at Bruce Terrace, Bow; while that of the South Metropolitan Company at Hill Street, Peckham, was 16·42 candles. The lowest illuminating power during the quarter was 15·5 candles in the case of the Chartered gas; 14·3 in that of the Imperial; and 15·3 in that of South Metropolitan. The cannel gas of the Chartered Company ranged from 20 standard candles to 22·4, the average for the whole quarter being 20·8 candles. It thus appears that the illuminating power of the gas supplied to each of the testing places has been at all times equal to the requirements of the several Acts of Parliament, viz., 16 standard sperm candles for the gas of the Chartered Company, and 14 for that of the two others. As regards purity, Dr. Letheby reports that on six occasions the gas of the Chartered Company at Ladbroke Grove was charged with sulphuretted hydrogen. The same was the case on five occasions with the gas of the Imperial Company at Bruce Terrace. The average amount of sulphur in the gas at the several places was as follows:—Beckton, 12·27 grains per 100 cubic feet; Cannon Street, 10·37; Friendly Place, 9·83; Ladbroke Grove, 17·49; Millbank, 17·68; Carlyle Square, 14·99; Camden Street, 17·34; Graham Road, 15·59; Bruce Terrace, 10·83; and Hill Street, 19·86. The proportion of this impurity was in excess of the prescribed quantity on one occasion at Camden Street, on three occasions at Bruce Terrace, and on four occasions at Hill Street, Peckham. All these have been the subjects of special enquiry; and Dr. Letheby states that the excess of impurity (sulphur and sulphuretted hydrogen) was due to accidental derangements of valves in the case of the Chartered and Imperial gas, but he was unable to find a satisfactory cause for the excess of sulphur in the gas of the South Metropolitan Company. The proportion of ammonia in the gas of the

several companies averaged 0·77 of a grain per 100 cubic feet of the gas at Beckton; 0·46 at Cannon Street; 1·11 at Friendly Place; 0·13 at Ladbroke Grove; 0·07 at Millbank; 0·47 at Camden Street; 1·19 at Hill Street; and 0·0 at Carlyle Square, Graham Road, and Bruce Terrace. The maximum amount of this impurity in the Chartered gas was 2·2 grains per 100 cubic feet; in the Imperial gas, 1·5 grains; and in the South Metropolitan, 2·4 grains. In no case, therefore, did the ammonia exceed the prescribed quantity of 2·5 grains per 100 cubic feet. Dr. Letheby concluded his report to the Metropolitan Board of Works by stating that the testings at their stations were defective on thirty-nine occasions, from causes referred to in the tables which accompanied his report.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the mode and apparatus for destroying and preventing acidity in beer. Edmund Richard Southby, analytical chemist, of Willes Road, Kentish Town, Middlesex. April 20, 1874.—No. 1361. When the beer is acid I neutralise or partially neutralise. I then heat the beer to the temperature required to destroy or render quiescent the acid ferments. For this purpose I use a closed vessel strong enough to withstand the pressure of the gases evolved, or connected with a condenser by which to save the alcohol and other volatile matters which may be returned to the beer. Within the vessel I use a coil pipe for heating by steam or hot water, and afterwards use the coil as a refrigerator by passing cold water through it; and to cause circulation in the beer I enclose the said coil in an open cylinder reaching from near the bottom of the vessel to within a few inches of the surface of the liquid. I then allow the insoluble matters to deposit, and mix the beer so treated with other sound beer, preferably with beer recently brewed and at the time of racking. Beer containing a portion so treated is found to possess extraordinary keeping qualities, and the flavour is rather improved.

Improvements in the preservation of alimentary substances. Miles Henry Smith, chemist, of Wandsworth. April 22, 1874.—No. 1394. This invention relates to the preservation of alimentary substances, such, for example, as fish, flesh, and fowl, and consists in the employment for such purposes of aldehyde either alone or in solution, or in combination with other substances and compounds having aldehyde as their base or as one of their constituents. In carrying out this invention I cause the alimentary substances to be preserved and contained in suitable vessels to be placed in or in contact with aldehyde, or with a solution of aldehyde or of such substances and compounds which may have aldehyde as their base or as one of their constituents, such solution being either in water or in any other suitable solvent of the same; and having so impregnated or immersed the alimentary substances, the vessels containing the same may be closed either hermetically or otherwise.

New or improved means or agents for disinfecting and deodorising purposes. Ernest Hart, Queen Anne Street, Marylebone, Middlesex. April 22, 1874.—No. 1398. Chloride of calcium, or magnesium, or sodium are combined with hydrochloric or other cheap acid. Or the combination is made of chloride of calcium or magnesium with a small proportion of chloride of sodium.

An improved method of and apparatus for the deodorisation and utilisation of sewage. William Robert Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. (A communication from Leopold Hesse, merchant, Melbourne, Victoria.) April 23, 1874.—No. 1415. The improved method of deodorising and utilising sewage, which forms the chief part of this invention, consists first in distilling it; and, secondly, in providing some suitable ingredient for retaining the valuable portion of the vapours given off from the boiler or retort. The apparatus in which I conduct these operations consists of an agitator working in a large reservoir, one or more boilers or retorts, and a series of Woolff's bottles to each retort.

A new process for preserving eggs by means of the carbonic anhydride and alkaline silicates. Emile Budde, doctor chemist, Auteuil, Paris. April 24, 1874.—No. 1428. The process, the subject of this invention, consists of two parts. The first is preparatory: the gases contained in the eggs are replaced by a scentless gas that cannot be respired, preferably carbonic anhydride, but carbonic acid, hydrogen, azote, or a mixture of these gases may be used. The substitution is effected by evacuation or by diffusion. To effect the first, the eggs are placed in a strong vessel perfectly closed, a vacuum is produced, and then the gas to be used is admitted. To effect the second, the eggs are placed in contact with the carbonic anhydride under ordinary pressure for, say, from twenty-four to forty-eight hours. The second part of the process has for its object to render the shell of the eggs impervious. They are steeped in a solution of silicate of soda or of potassa, and when withdrawn are left to dry, the process being then completed. In treating perfectly fresh eggs the preparatory operation is not needed, steeping them in the solution suffices.

Improvements in the manufacture and separation of certain mixed coal-tar products. Charles Lowe and John Gill, manufacturing chemists, both of Manchester, Lancaster. April 24, 1874.—No. 1435. The object of this invention is to effect and facilitate the separation of carbolic acid from the cresylic and other liquid tar acids. The nature of this invention is—(1) to submit the partially or wholly hydrated mixtures of tar-acids above mentioned to the sufficiently prolonged action of temperatures varying between 15° F. and 56° F.; (2) to separate by suitable means the more or less hydrated carbolic acid crystals thus formed from the mother-liquors containing the liquid tar-acids and a residue of carbolic acid dissolved in them; (3) to effect complete purification of the more or less hydrated carbolic acid crystals thus obtained by re-crystallisation either by partial fusion or solution in water with subsequent refrigeration; and (4) to prepare carbolic acid of high or complete degrees of purity by dehydrating the partially or wholly purified more or less hydrated carbolic acid crystals above mentioned.

Improvements in treating guano. William George Sharp Mockford, manufacturing chemist, Old Broad Street, London. April 25, 1874.—No. 1450. This Provisional Specification describes reducing megillones or other guano to a fine state of division by grinding, and then adjusting the percentage of nitrogen by the addition of nitrate of soda, also in a state of powder, and mixing the nitrate with the guano. Or in some cases the nitrate of soda may be used in a state of solution before it has been boiled down, and crystallised, and mixed with the crude guano. The compound is then thoroughly dried in a stove, and is afterwards ground to a fine powder.

Improvements in dyeing wool and silk fabrics or materials. John Garrett Tongue, of the firm of Tongue and Birkbeck, patent agents and engineers, Southampton Buildings, Chancery Lane, Middlesex. (A communication from Ivar Bang, chemist, Paris.) April 25, 1874.—No. 1451. This invention relates to a new method of obtaining a dye upon stuffs, woollen material, and silk, this new or improved colour being called French blue, or cyanide of blue. To obtain these colours, the wool or silk is dyed in a bath containing ferricyanide of potassium, sulphuric acid, and an alum mordant, according to the usual practice; but the true colouring matter is the ferricyanide, which, under the influence of sulphuric acid, is dissolved in sulphate of potash and in ferricyanhydric acid.

A new compound of lead, applicable to the purposes for which white-lead and red-lead are employed, and the process for producing such compound from galena. Jules David, Rue Saint Anne, Paris. April 27, 1874.—No. 1454. This invention consists in producing a new substance termed "galenite" from sulphuret of lead. Galena is reduced to powder, and is oxidised at a low red-heat in open retorts, and is thus converted into a bibasic sulphate, which is then ground between millstones immersed in water. The liquid thus obtained is placed in vats; and the suspended matter is allowed to deposit, and is dried, and constitutes the new substance termed "galenite," which is applicable for all purposes for which red-lead and white-lead are employed.

Improvements in the manufacture of white- and red-lead and litharge. William Baker, Sheffield, York. April 28, 1874.—No. 1474. This invention for improvements in the manufacture of white-lead and of red-lead and litharge, consists in the employment of lead alloyed with a certain amount of zinc; such lead to be used for the making of red-lead litharge, or cast for corrosion in the usual manner for its exposure to the action of carbonic acid, aqueous vapour, and acetic acid, according to the usual methods of making white-lead.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 1st.—Medical, 8.
—— London Institution, 5.
—— Society of Arts, 8. (Cantor Lectures.) "Alcohol, its Action and its Use," by Dr. B. W. Richardson, F.R.S.
—— Royal Institution, 2. General Monthly Meeting.
TUESDAY, 2nd.—Civil Engineers, 8.
—— Royal Institution, 3. E. Ray Lankester, M.A., "On the Pedigree of the Animal Kingdom."
—— Zoological, 8.30.
WEDNESDAY, 3rd.—Microscopical, 8. (Anniversary.)
—— Pharmaceutical, 8.
—— Society of Arts, 8. Mr. J. A. Coleman, C.E., "The Protection of Buildings and Ships from Fire, with Arrangements for the Ventilation of Ships."
THURSDAY, 4th.—Royal, 8.30.
—— Chemical, 8.
—— Royal Society Club, 6.30.
—— Royal Institution, 3. Professor Tyndall, "On Subjects Connected with Electricity."
FRIDAY, 5th.—Royal Institution, 8. Weekly Evening Meeting. Mr. James Dewar, "On the Physiological Action of Light," 9.
—— Geologists' Association, 8. (Anniversary.)
SATURDAY, 6th.—Royal Institution, 3. Mr. J. T. Wood, "On the Discovery of the Temple of Diana, and other results of the Government Excavations at Ephesus."

UNIVERSITY COLLEGE, LONDON.

ELECTRICITY and MAGNETISM.—Professor G. C. FOSTER, F.R.S., will begin a Course of about Fifty Lectures on ELECTRICITY and MAGNETISM on Friday, 12th of February, at 4 p.m., to be continued on succeeding Mondays, Wednesdays, and Fridays at the same hour. Fee for the Course, £5 5s.

Practical Instruction in the Methods of Electrical and Magnetic Measurement is given in the Physical Laboratory of the College.

For further information apply to the undersigned.

JOHN ROBSON, B.A., Secretary to the Council.

THE CHEMICAL NEWS.

Vol. XXXI. No. 793.

ON ATTRACTION AND REPULSION RESULTING FROM RADIATION.*

By WILLIAM CROOKES, F.R.S., &c.

(Concluded from page 45.)

74. Throughout the course of these investigations I have endeavoured to keep in my mind the possible explanations which may be given of the actions observed, and I have tried, by selecting some circumstances and excluding others, to put each hypothesis to the test of experiment. The most obvious explanation is that the movements of the beam, or of the horizontal index (69, 70), are due to the currents formed in the residual gas, which, theoretically, must be present to some extent even in those vacua which are most nearly absolute.

In favour of this explanation it may be urged that a highly rarefied gas may be much more mobile than when it is denser, and therefore the more rapid impingement of its particles, when set in ascension by warmth, would increased their mechanical action. Increased momentum may counterbalance diminished number.

That the residual gas in an air-pump vacuum is capable of exerting considerable mechanical action, may be assumed by the phenomena attending the passage of meteorites through the upper regions of the atmosphere, their friction against the air at an average height of 65 miles above the earth's surface raising them to incandescence, although at that height the attenuation of the air probably surpasses that of most artificial vacua.

On the other hand, it is most difficult to believe that the residual air in a Sprengel vacuum, where the gauge and barometer are appreciably level, can exert, when gently warmed by the finger, an upward force capable of instantly overcoming the inertia of a mass of matter weighing several grains, and setting it in motion. It must be remembered that the upward current supposed to do this is simply due to the diminished weight of a portion of the gas, caused by its increase in volume by the heat applied.

75. Another argument in favour of the air-current explanation can be drawn from the fact that when a light beam, having equal weights of pith and platinum suspended at the ends, is sealed up in a Sprengel vacuum, the application of warmth below causes the pith to rise more readily than the platinum (62); the pith obviously offers a much more extended surface than the platinum does to the impact of air-particles.

This, moreover, is not an isolated instance. Throughout the whole of these experiments the law appears to be that the force exerted is in proportion to the extent of surface exposed (48, 62, 63, 64, 65, 67) rather than in proportion to the mass. Much surface and extreme lightness are the requisites in selecting materials for the beam, index, or gravitating mass; and when the masses have the same specific gravity and extent of surface, their position in respect to the source of heat determines the extent of movement. Thus a cylinder of pith is more sensitive when arranged for the heat to act on its side than on its end; and the film of mica in experiment 65 was more affected when the heat struck its flat surface than its edge, although the difference was not so great as might have been expected had air-currents been the cause of motion.

76. But these facts can equally well be used on the opposite side; for assuming that the movement is due to a repulsive action of radiation, it is reasonable to suppose that extended surface, weights being equal, would have an advantage. The repulsion by radiation only acts on the surface of bodies, and does not seem to act on the molecules which constitute thickness. When radiant heat gets below the surface of a body, it spends itself in doing mechanical work of another kind, viz., dilatation or expansion.

77. However strong may be the reasons in favour of the air-current explanation, they are, I think, answered irrefragably by the phenomena themselves. An air-current produced by heat can cause the beam of a balance to rise, can drive a suspended index sideways, and, by a liberal assumption of eddies and reflections, can perhaps be imagined to cause these movements to take place sometimes in the opposite directions; but as rarefaction proceeds these actions will certainly get less, and they will cease to be appreciable some time before a vacuum is attained; a point of no action or neutrality will be reached. But this neutral point should certainly be nearer a vacuum when a light body exposing much surface, such as pith, is under experiment than when the mass acted on is heavy like brass; whereas in practice the contrary obtains. Pith and thin glass balances, which should be sensitive to highly attenuated air-currents, cease to respond to heat at a rarefaction of 7 millims. (30) and 45 millims. (66), whilst brass only ceases to be affected when the gauge and the barometer are appreciably level (43).

But even could the phenomena up to neutrality be explained by air-currents, these are manifestly powerless to act after this critical point is passed. If a current of air within 7 millims. of a vacuum cannot move a piece of pith, certainly the residual air in a Sprengel vacuum should not do so; and, *a fortiori*, the residual air in a chemical vacuum could not move a piece of platinum (55).

It is, however, abundantly demonstrated that in all cases, after this critical point is reached, the repulsion by radiation is most apparent, and it increases in energy as the vacuum approaches perfection.

78. Again, the movements not only reappear on passing a particular point of atmospheric density, but they take place in the opposite direction (31, 32, 33, 44, 46, 66). Thus in all cases, when the atmospheric density is between the neutral point and a vacuum, the action of a body hotter than the moving beam or index is to repel it, whilst the action of a colder body is to attract. Now it is very probable that were it not for the interference of air-currents the action in air of greater density would always be for the hot body to attract. This is actually the case in many experiments (27, 37, 38, 40, 41, 66, 70, 72); and observations more recently made, but only alluded to in par. 72, have proved that in air of ordinary density a cold body repels.

On the supposition that air-currents are the motive power, the effects noticed when the source of heat is internal to the tube, and applied above the moving beam (37, 39, 40, 41, 45), are inexplicable, whilst they are easily comprehended on the repulsion-by-radiation hypothesis.

If an additional argument is necessary to show that air-currents are not the cause of the repellent action of a hot body, I bring forward the fact that the movement attains its maximum when there is no air at all present (54, 55, 68).

79. Effects probably due to this repulsive action of radiation are constantly met with. I will instance the following:

Cohesion and adhesion are diminished by heat. This naturally follows if increased temperature augments the force of repulsion between the molecules.

The phenomenon of the spheroidal state is probably due in some measure to a repulsive force exerted between closely approximated bodies, one of which is at a very high temperature. This action is generally supposed to take place only when one of the bodies is volatile, and the rapidly formed skin of vapour is held to be a sufficient cause of non-contact. I venture to anticipate that a condition similar to the spheroidal state will be found to obtain between non-volatile bodies.

* From the *Philosophical Transactions of the Royal Society of London*, vol. clxiv., part 2.

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Many finely divided chemical precipitates, when incandescent in a platinum crucible, assume a remarkable mobility and flow about like water. Precipitated silica is an instance which will occur to chemists. A space can readily be distinguished between the powder and a hot capsule containing it. Electricity may, however, play some part in this action; for precipitates, when heated, sometimes become sufficiently electrical by stirring with a glass rod to fly out of the basin containing them; oxalate of lime possesses this property in a remarkable degree.*

80. It must, however, be remembered that my experiments show the action of hot bodies in air to be that of attraction, and that the repulsion by heat only becomes evident near upon a vacuum. It is seen, therefore, that radiant light or heat has an attractive or repulsive action, according to the medium in which it acts, corresponding results being furnished by cold. There appears to be an interfering action of air other than that of the currents caused in it by heat, which masks or overcomes the true action of heat; but in a vacuum this interfering cause is absent, and radiant heat is free to exert its full repellent action, whilst cold or negative heat acts in the opposite direction. Heat and cold, heat present and heat absent —molecular activity and molecular rest—are therefore antagonistic in their action on a body free to move in empty space. The molecules of matter whose mode of motion constitutes heat are drawn together and condensed as these vibrations diminish in amplitude, whilst heat drives them apart, expanding a solid, changing a solid into a liquid and a liquid into a gas.

The masses used in my experiments are likewise repelled by heat and drawn together by cold. And it is with no weak force or feeble action that I have been dealing. It is so decided that in some of my balances the approach of a finger will completely overturn them, whilst the radiant warmth of the body affects them 6 feet off; and at higher temperatures and with larger masses the action must be still more energetic.

81. It is not unlikely that in the experiments here recorded may be found the key of some as yet unsolved problems in celestial mechanics. In the sun's radiation passing through the quasi vacuum of space we have the radial repulsive force, possessing successive propagation, required to account for the changes of form in the lighter matter of comets and nebulæ; and we may learn by that action, which is rapid and apparently fitful, to find the cause in those rapid bursts which take place in the central body of our system; but until we measure the force more exactly we shall be unable to say how much influence it may have in keeping the heavenly bodies at their respective distances.

So far as repulsion is concerned, we may argue from small things to great, from pieces of pith up to heavenly bodies; and we find that repulsion shown between a cold and warm body will equally prevail, when for melting ice is substituted the cold surface of our atmospheric sea in space, for a lump of pith a celestial sphere, and for an artificial vacuum a stellar void.

Attraction being developed by radiant heat under influences connected with air, it is not easy to conceive how it will be produced for cosmical purposes by heat; the upper surface of our atmosphere must present a very cold front, and from this we might argue repulsion by the sun, unless we fill space with a body acting like air, when we should have attraction. We might readily find conditions for both, but how to harmonise them is a difficulty.

Although the force of which I have spoken is clearly not gravity solely as we know it, it is attraction developed from chemical activity, and connecting that greatest and most mysterious of all natural forces, action at a distance, with the more intelligible acts of matter. In the radiant molecular energy of solar masses may at last be found that "agent acting constantly according to certain laws" which Newton held to be the cause of gravity.

* Faraday's "Experimental Researches in Electricity," vol. ii., p. 163.

SOME POINTS IN THE CHEMISTRY OF MILK.*

By C. A. CAMERON, M.D.,
Professor of Hygiene, Royal College of Surgeons, Ireland.

Colour of Milk.

The author states that the colour of milk is chiefly due to the reflection of light from the myriad of solid caseous capsules in which most of the fats of milk is contained. They are translucent, and (but to no great extent) refract light. In fresh milk there are globules of free fat, sometimes numerous, but rarely exceeding 0·0015" in diameter. By continued ebullition of a mixture of milk (rendered slightly alkaline with KHO) and other liquids, all, save the merest trace of fats, may be removed, leaving a perfectly milk-like liquid. Attention was called to the fact that butter-milk containing 0·5 per cent of fats was whiter than skimmed milk containing 1·3 to 2 per cent of fats. In the former the caseous envelopes of the so-called fat globules were left; from the latter a large proportion was removed, in the form of cream. From these and other facts the author concluded that the opacity and whiteness of milk were due not to the liquid being an emulsion of fats, but to the reflection and refraction of light by solid caseous matter suspended in it.

Cow's Milk.

The results of several thousand analyses of cow's milk made by the author, since 1865, led him to conclude that the mixed milk of town cows never contained less than 12, and that of country cows 11·5, per cent of solids; and he agreed with Prof. Wanklyn that the solids, minus fats, never sank below 11·3 per cent. Several hundreds of convictions for selling adulterated milk occurred in Dublin, and though in many cases the alleged amount of adulteration with water was only 12 per cent—and in each case a duplicate sample was produced in Court—the accused never elected to have it re-examined, though on other points barristers and solicitors constantly raised issues. Forty analyses of pure milk from Dublin dairy cows gave the following average results:—

Water	87·00
Fats	4·00
Albumenoids..	4·10
Sugar	4·28
Mineral matter	0·62
	100·00

Mare's Milk.

Gorup-Besanez, in page 416 of the second edition of his "Lehrbuch der Physiologischen Chemie," states that mare's milk contains 17·163 per cent of solids, including 6·872 per cent of fats. Clemm found it rich in solids, and to contain nearly 7 per cent of fats. Simon, in his "Physiological Chemistry," states it to be very rich in solids. It is probable that the milk analysed by these chemists could not have been that of the mare, which, being akin to the ass, would be likely to yield, like the latter, a milk poor in solids, and poorer still in fats. The author examined the milk of fourteen mares, and found the solids to vary from 8·5 to 11·5 per cent, the fats from 0·6 to 2·12, the casein from 1·46 to 2·4, the sugar from 5·67 to 6·87, and mineral matter from 0·33 to 0·44 per cent. The average of the fourteen specimens gave—

Water	90·310
Fats	1·055
Albumenoids	1·953
Sugar	6·285
Mineral matters..	0·397
	100·000

Mare's milk is bluish-white; sp. gr. about 1·031; reaction neutral, or faintly alkaline.

* Abstract of a paper read before the Royal Dublin Society, January 18, 1875.

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Sow's Milk.

The sow parts with its milk (except to its young) with great reluctance. Its sp. gr. is 1·041; its reaction faintly alkaline, and colour yellowish white: 100 parts contain (mean of two analyses)—

Water	81·760
Fats	5·830
Albumenoids	6·180
Sugar	5·335
Mineral matters	0·895
	100·000

These results show this species of milk to be very rich. It is remarkable that in the lactometer it shows up no cream. Drying on the water-bath it exhales the odour of roast pork, and on putrefying that of putrid bacon.

LABORATORY NOTES.

Limit of Weighing; Condensation of Air on Surface of Platinum; Gold-Lined Capsules; Weighing on Filters; Ready Method of Showing Absorption of Hydrogen by Palladium.

By J. LAWRENCE SMITH,
Of Louisville, Kentucky.

The Limit of Weighing.

In quantitative analyses there is, perhaps, no one part in the process on which more time is needlessly lost than at the balance. While a chemist should not consider any time lost which is needed for accuracy of results, yet he need not consume time attempting what is called accuracy of weighing far beyond the limit of error of the circumstances under which a balance in the laboratory, with the containing vessels of platinum, glass, and porcelain (used to contain the materials weighed) is placed. Some of our most accurate and distinguished analytical chemists, as Rose and others, we are informed, only weighed within 1 m.grm., using 1 to 2 grms. of the material; in my own practice, using from 0·500 to 1 grm., I consider it useless to weigh nearer than ½ m.grm. A little practice will soon enable any one to judge where to place the last ½ m.grm.

My remarks thus far apply to the great run of accurate chemical analyses. When it comes to the more precise study of atomic weights, I still adhere to the limit of ½ m.grm., but increase the amount of material experimented with.

In regard to assay analyses of gold and silver, of course these rules are not meant to apply, for there we have a special balance whose beam is no larger than a wire, and whose entire range is very small, and therefore can be kept to an adjustment far exceeding anything that can be done with analytical balances of the most approved make.

Condensation of Air on the Surface of Platinum.

In connection with the subject of weighing, I would add the following observations of mine on platinum vessels.

After taking the weight of a clean platinum vessel, then wiping it thoroughly with a dry rag or soft paper, and replacing it on the pan of the balance, it will be found to have lost weight; if of the ordinary size used in quantitative analysis, it will be found to have lost 2 m.grms. or more. If allowed to remain on the balance for fifteen or twenty minutes, it will be found to have recovered its weight. This change has usually been attributed to moisture, but I have clearly established that this is not the case. The following is the result of some accurate experiments:—

A new flat-bottom capsule, 4 centimetres in diameter and 2 centimetres deep, having about 50 centimetres square of surface inside and outside, was first thoroughly cleaned by boiling in a solution of caustic soda. After thorough washing in distilled water, it was heated to redness, allowed to cool, and in one hour weighed. It was now taken from the balance and wiped with clean filter-paper, taking care to touch, as far as possible, all parts of the surface, without using any violent friction. After being submitted to this operation it was replaced on the balance, and it was ascertained to have lost 2 m.grms., and after being allowed to remain for twenty minutes its original weight was restored.

The vessel was now transferred to a drying receiver over sulphuric acid, and allowed to remain six hours; placed on the balance, it weighed exactly what it did when placed in the drying receiver. It was now wiped as before, and on being replaced on the balance had lost 2 m.grms., which it recovered, as before, in fifteen or twenty minutes.

The vessel was now transferred to a receiver in which the air was saturated with moisture from wet paper, placed on the glass support. After six hours the capsule was placed in the balance, when it was found to weigh just the same as it did when it was introduced into the moist atmosphere. A dry atmosphere or a moist atmosphere was then shown to have no effect in producing this temporary loss of weight in the capsule.

From these experiments, it shows very clearly that there is air condensed on the surface of platinum that a little rubbing will remove; but it will soon return to the platinum after this treatment. The importance of this fact will be manifest to the analytical chemist, and make him cautious about taking the tare of his platinum vessels too soon after wiping them.

Gold-Lined Capsules and Crucibles.

While the analytical chemist cannot always indulge in every form of luxury of apparatus which might tend to facilitate and give precision to his researches, still they are very convenient and useful at times. Those who have had much to do with caustic potash and nitre heated to redness, know that silver vessels will not always answer their purpose. Under these circumstances gold vessels are very useful, but very expensive, and I have for some time been using what might be called a compromise vessel, made of platinum lined with gold; not platinum gilt, but made in the following manner:—A thick sheet of platinum is taken and the requisite amount of gold melted on the surface, the whole is then rolled out to the proper thickness for capsules and crucibles, and these latter vessels then made out of this sheet. There was some little difficulty attending the making of the first vessels, but this was entirely overcome in the establishment of Johnson, Matthey, and Co., Hatton Garden, London, where the vessels I use are made.

Weighing on Filters.

In weighing precipitates on the filter, the common method I employ is to take two filters of the size required, which have been cut to size together. These filters are placed on the balance and weighted one against the other. Ordinarily there will be but a few m.grms. difference in weight, which difference is marked in small numbers with pencil on the heavier. These filters are placed on the funnel side by side, the substance to be filtered is poured on one, and the filtrate from the first is poured on to the second filter, and so with the washings. When the filtration and washing are complete, the two filters are placed on the warm bath and dried; the weighing being conducted in the ordinary way, only the empty filter is placed on the balance as a tare to the other, and due allowance made for the excess of weight of one filter over the other in taking account of the weight of the substance. This has some advantages over the ordinary way with the filter, as there is no need of any special precaution of washing the filter prior to use in any way, or drying in a glass tube, and using any precaution against the hygroscopic moisture that is likely to be absorbed by the dry filter, for there is always a filter an each side of the scale subject to like conditions. It enables me at least to dispatch my work more readily and satisfactorily.

A Ready Method of showing the Absorption of Hydrogen by Palladium.

In the beautiful and important investigations of Graham upon the absorption of hydrogen by palladium, he described

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a very pretty method of making this absorption very apparent to the eye, viz., to take a strip of thin palladium, place wax or other non-conducting and pliable substance on one surface of the strip, and then attach it to the proper pole of a galvanic battery, and plunge it into water acidulated with sulphuric acid, when the hydrogen that is evolved at that pole, instead of escaping as gas, is absorbed by the palladium, which now bends and coils up on itself in virtue of the expansion on the exposed side.

This same result I have been in the habit of exhibiting in my laboratory, with a small piece of very thin palladium, about 1¼ centimetres wide and 8 centimetres long. Light a small-sized Bunsen burner, hold the piece of palladium in the upper part of the flame; it will get red-hot, but remain in the same form as when introduced in the flame. Lower it now into the flame, until the unburnt gas from the centre of the flame strikes the bottom of the metal, when it will immediately coil upwards, and can be made to double on itself. Carry it back to the upper part of the flame and it will straighten itself again. There are some interesting chemical questions connected with this experiment that are worth working out, and at some leisure moment I will look into them; as, for instance, the absorption of the gas at this high temperature, and as to whether or not simply hydrogen is absorbed, the palladium thereby decomposing the hydrocarbon, &c.

THE PRODUCTION OF ANILINE COLOURS WITHOUT THE USE OF ARSENIC ACID.

It will be within the remembrance of readers of the Chemical News that Coupier, of Paris, was the first to succeed in producing fuchsine by the action, at a suitable temperature, of hydrochloric acid and iron in small quantities on pure aniline and nitrotoluol. Though Coupier's experiments were confirmed by Schützenberger, who showed the aniline-red obtained by Coupier's process to be identical with that usually manufactured, and found the yield somewhat greater than that obtained by the use of arsenic acid, the process was not applied industrially before 1872, when Meister Lucius, and Brüning, of Hoechst, Germany, succeeded in working it on a large scale. This firm, however, appear to manufacture their colours only in part by this method, as they still supply the market with dyes containing arsenic.

More recently, the Gesellschaft für Anilin Fabrikation, of Berlin, have erected new works, where no arsenic acid is used in the preparation of colours. Not only fuchsine (rubine), but all the colours derived from it which are manufactured by this company are warranted to be produced without the employment of arsenic, and to be entirely free from this poisonous reagent.

The Berlin Company are working Coupier's process with several important modifications, and produce from 200 to 300 kilogs. of fuchsine per diem. Some specimens of fuchsine and other colours manufactured by this Company appear to be products of unrivalled beauty, purity, and strength. The fuchsine is stated to be not only purer, but stronger than that made by the aid of arsenic acid, and is the pure hydrochlorate of rosaniline. The rosaniline base, from its great purity, is admirably adapted for the preparation of aniline blue, and is largely used by other manufacturers of aniline colours.

Being free from arsenic, these dyes are not only fitted for colouring sweetmeats, liqueurs, syrups, and pharmaceutical preparations of every description, but may be used in many other industrial purposes where poisonous colours would be more or less dangerous, as in the staining of paper, paper-hangings, toys, &c.

It is to be desired that other manufacturers of these dyes will adopt the new method, and relinquish the old arsenic acid process, which, apart from the inconveniences it has caused both manufacturers and consumers, has led to many lamentable accidents.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Annual Meeting, 1874.

E. W. Binney, F.R.S., F.G.S., Vice-President, in the Chair.

The Report of the Council was read, from which we extract the following:—

Dr. Frederick Crace-Calvert, F.R.S., was born near London, on the 14th of November, 1819.

In the year 1835, when 16 years of age, he left London and went to France, where he commenced the study of Chemistry under the celebrated chemist Gerardin, at Rouen, and continued with him for two years. At the expiration of this time he went to Paris, and carried on his studies at the Jardin des Plantes, the Sorbonne, Collége de France, and École de Médecine, his attention being principally given to the Natural Sciences.

About the age of 21 he was appointed to manage the well-known works of Messrs. Robiquet and Pelletici, where the manufacture of pure chemicals and pharmaceutical products is carried on. This position, however, he soon vacated, on being offered that of "Démonstrateur de Chimie Appliquée," under the eminent chemist Chevreul, and here he remained from 1841 till 1846, when he left France. From the former date his career as a chemist began, and continued with untiring energy during the succeeding thirty-two years.

He published his first paper, "Sur l'Extraction de Quinine et Cinchonine," in September, 1841.

In 1843, in conjunction with M. Ferrand, he elaborated an interesting paper on the analysis of gases enclosed in some organs of plants, the gases being taken from the same plants at different times of the day and year, to demonstrate the action of the sun's rays. This paper is entitled "Memoire sur la Végétation, and may be found in vol. v. of the *Comptes Rendus*. In the following year the diseases of beer engaged his attention, and some interesting facts were embodied by him in a paper read to the Société de Pharmacie, "Sur la Fermentation visqueuse de la Bière."

From 1843 till the time of his leaving France he was engaged in a research on some compounds of lead, which first brought him into note. One of the papers consequent on this may be found in the *Comptes Rendus* of 1843, entitled "Procédé au moyen duquel on obtient un Protoxyde de Plomb cristallisé at ayant la Couleur du Minium."

In 1844 he wrote "On the Presence of Indigo in the Orchidaceous Plants;" in 1846, "On the Preparation of Calomel on the Large Scale;" and, in the same year, a compilation of facts relating to the properties of animal-black.

On returning to England, at the latter end of 1846, he was first appointed to the chair of the honorary professorship of chemistry at the Royal Institution, and afterwards to that of lecturer on chemistry at the School of Medicine in Pine Street, Manchester.

In 1847 he published a paper "On Bleaching Powders," and in 1848 one "On the Bleaching of Cotton and Flax."

About this time Dr. Calvert gave a long series of lectures on his favourite subject, at the Athenæum, Manchester, "The Application of Chemistry to Manufactures." These were recorded in the daily papers.

During the following years many other subjects engaged his attention, but we may notice the following publications as some of the results of his labours:—

In 1849, "Process for the Preparation of Chlorates, particularly the Chlorate of Potash."

In 1851, "On the Oxides and Nitrates of Lead."

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In 1854, "A case of Poisoning by the Sulphate of the Protoxide of Iron."

In 1855, "On the Adulteration of Tobacco."—"On the Action of Organic Acids on Cotton and Flax Fibres."—"On the Actions of Gallic and Tannic Acids in Dyeing and Tanning."

In 1856, "On the Solubility of Sulphate of Baryta in Different Acids."—"On the Purification of Polluted Streams."

About this time he commenced an enquiry, in conjunction with Mr. Richard Johnson, on the physical and chemical properties of different alloys. The publications resulting from these investigations were—

In 1858, "On the Hardness of Metals and Alloys."—"On the Conductibility of Metals and Alloys."—"On the Chemical Changes which Pig-Iron undergoes in its Conversion into Wrought-Iron."

In 1861, a series of papers "On the Expansion of Metals and Alloys."

In 1862, "On the Composition of a Carbonaceous Substance existing in Grey Cast-Iron."—"On the Employment of Galvanised Iron for Armour-Plated Ships."—"On the Conductibility of Heat by Amalgams."

In 1863, "On the Preservation of Iron-Plated and other Ships."

The interest he took in the preservation of ships from the action of sea-water never ceased; many unrecorded experiments were carried on by him at intervals on this subject till the last days of his life.

In 1865 Mr. Richard Johnson and he published "On the Action of Sea-Water on certain Metals and Alloys," and in 1866 "On the Action of Acids on Metals and Alloys."

In 1870 two papers appeared by Dr. Calvert; one "On the Composition of Iron Rust," the other "On the Oxidation of Iron;" and a third on the same subject in 1871.

In 1858 we find a publication of his "On a New Method of preparing Hydrochloric Acid."

In 1859, "On the Analyses of Wheaten Flours."—"Influence of Science on the Arts of Calico-Printing."—"On Starches: the Purposes to which they are Applied, and Improvements in their Manufacture."

During this year his attention was called by the late Dr. Ransome to hospital gangrene, and in seeking its cause he was led to investigate the compounds produced during putrefaction.

Two papers, descriptive of his results, appeared in 1860; the first "On Products of Putrefaction," the second "On New Volatile Alkaloids given off during Putrefaction."

He continued, during the following two or three years, with these researches, and had collected about an ounce of a precipitate, produced by combining the gaseous products of putrefaction with platinum, by passing the gases emitted by the putrefying meat through bichloride of platinum, by means of aspirators, during many months. This accumulation of precipitate was unfortunately destroyed before its examination could be completed, through the carelessness of one of his assistants, which caused him much regret ever afterwards.

In 1861 he wrote "On Improvements in the Manufacture of Colouring Matters," and "On the Chemical Composition of Steel." A report followed "On the Action of Water supplied by the Manchester Corporation on Lead of different kinds," in connection with the Manchester Sanitary Association.

In 1862 he gave a series of lectures to the Society of Arts, "On the Improvements and Progress in Dyeing and Calico-Printing since 1851;" in 1864, "On Chemistry as applied to the Arts;" in 1866, "On Discoveries in Agricultural Chemistry," and "On Discoveries in the Chemistry of Rocks and Minerals." These were the beginning of the Cantor lectures, which are now continued every year by different lecturers.

In this same year we find another paper by him "On Wood for Ship-building."

In 1863 he patented and worked at his process for the separation of sulphur from coke, by use of common salt, for the purpose of the manufacture of iron of superior quality.

The following is a list of some of his further publications—

In 1865, "On the Action of Silicate and Carbonate of Soda upon Cotton Fibres."—"On the Crystallised Hydrate of Phenic Alcohol."

In 1866, "On the Hydraulicity of Magnesian Limestone."—"On the Preparation of Acetylene."

About this time he interested himself with the properties of phenic or carbolic acid, and, being satisfied of its valuable disinfecting properties, built works for its manufacture, and to him belongs the honour of having first brought it in a pure state into commerce.

In 1867 he wrote papers "On Oxidation by means of Charcoal," "On the Presence of Soluble Phosphates in Cotton Fibres, Wheat, and other Seeds," and five articles "On the Synthesis of Organic Substances."

In 1867, "Carbolic or Phenic Acid and its Properties" (three articles).

In 1869, "Presence of Soluble Phosphates in Seeds."—"Preparation of Nitrogen."

In 1870, "Testing Petroleum."

In 1872, "Sulphur in Coal and Coke;" and papers on "Protoplasmic Life," "Vitality of Disease Germs," &c. Part of the latter series remains yet unpublished.

In concluding the list of Dr. Crace-Calvert's various researches, we may mention that, besides the above, many others were made by him, but their unfinished state does not justify publication. Among these may be mentioned one on "Light," which cost him much labour, and one "On the Action of Different Gases on each other under Enormous Pressures."

He was a Fellow of the Royal Society, of the Chemical Society, and of many other Societies both at home and abroad.

Dr. Calvert showed remarkable devotion to the science he studied, and his knowledge of its literature was such as very few have attained, and such also as could only be obtained by a most unusual amount of reading, accompanied with strong interest, and in all probability much pleasure. He showed this knowledge more in the departments referring to industry, and, as might be expected, he intended to give his experience to the public in a more convenient form than his lectures presented. One of these works, that relating to "Colours other than Aniline," was nearly completed—if not entirely so—before his last illness, and is expected to be published shortly. Whilst rather exhausted with this work, added to the attention required for the manufactures in which he was engaged, he was chosen as one of the jury of the Vienna Exhibition. The summer of 1873 was sultry and unpleasant, and other causes may have operated to make it unhealthy; but whatever the reason or combination of reasons may have been (and we cannot doubt that work and anxiety contributed), the result was that Dr. Calvert returned in a very enfeebled state, and a few days after his arrival in Manchester was seized with a fatal illness, which terminated on the 24th of October of the same year.

He was a firmly built man, of middle height, and apparently of unusual strength. His hair was dark, and he seemed to be younger in constitution than his years indicated. His manner was animated, and he had great pleasure in communicating information. It is not attempted in this notice to say to what extent his writings have contributed to the advance of science or the knowledge of manufactures, but in the latter department it is certain his influence was widely felt, and his friendly disposition enabled him to become a frequent medium of communication between scientific men in England and in France, in both of which countries he felt equally at home. With these combined characteristics the position he made for himself was peculiar, and of its importance we may judge partly by the fact that, although one to which many would be glad to attain, it is not yet filled up.

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PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

IN pursuance of an arrangement with the Editor of the CHEMICAL NEWS, a certain space in this Journal will henceforward be devoted to the interests of the above Society.

That the Public Analysts of the United Kingdom have formed an Association is probably pretty generally known already to the chemical world; but as this is our first appearance in a literary form it becomes us, in this place, to justify our existence.

With this view we propose to lay before our readers, as succinctly as may be, the history of our origin, and an explanation of the objects we have in view.

As long ago as 1860, the attention of Parliament was directed (mainly as the result of the extensive and valuable researches of Dr. Hassall and others) to the question of the adulteration of food, and a Bill for the repression of such adulteration—at that time very widely spread—was passed.

This Bill, however, from the defective machinery arranged for carrying out its object, was practically inoperative, and in 1872 the subject again called for and received the attention of the Legislature.

The Act of 1872—though a great improvement on the previous measure, and though it has admittedly been the means of checking, in a very great degree, the evil which it was its object to prevent—has not been successful to the extent that was hoped and expected. This has arisen from various causes, among which we may mention that the Bill was drawn by gentlemen who were but imperfectly acquainted with the subject; that it has been only very partially put into operation; that the number of chemists, alike able and willing to undertake the new duties required, was, at the time of its enactment, extremely limited; and that, from the loose wording of some of its clauses, the decisions of magistrates have frequently not been in accord one with another.

Besides this, it must be remembered that the tradesmen likely to be affected by an "Adulteration Act" form, in the aggregate, an enormous, wealthy, and influential body, and having, by a long immunity, acquired more or less lax ideas of what should be considered purity and what adulteration (though we do not mean to imply that they were less honest than their neighbours who were unaffected by the Act), they very naturally resented any interference with their "vested interests;" and "vested interests" being in England uncommonly awkward things to meddle with, it is no matter for surprise that they obtained considerable sympathy from the general public, who, with wonderful unselfishness and self-abnegation, consented to swallow chicoried coffee, alumed bread, and watered milk, rather than that the grocer, the baker, or the milk-seller should be subjected to what appeared to them like oppression.

The complaints of the tradesmen, and the defects in the Bill itself, which daily became more apparent, at length led—as will be in the recollection of our readers—to the appointment, during the last Session of Parliament, of a Select Committee of the House of Commons, to enquire into the working of the Act, with a view to its amendment. Mr. Clare Sewell Read, the Secretary of the Local Government Board, very ably presided over the deliberations of the Committee; and after numerous witnesses had been examined, the Committee issued a Report, which, together with the detailed evidence given before them, forms a Blue Book of more than 400 pages.

It is not our intention here either to animadvert upon the constitution of the Committee or to criticise any of the statements made before them. Suffice it to say that three things were made manifest:—

First. That further legislation is probable, and this by itself pointed to the desirability of concerted action on the part of Public Analysts.

Second. That the representatives of each trade, though approving of the repression of adulteration in the abstract, held that their particular business should be exempted from the operation of any Adulteration Act,—so that if each section of trade was to be conciliated, no Adulteration Act whatever could be passed.

Third. That, partly through ignorance and partly through prejudice, statements were made which the Public Analysts considered to reflect very unjustly on their ability and procedure.

It will thus, we think, be admitted that sufficient cause existed for the formation of our Society; and after a preliminary meeting of some half dozen Public Analysts, a general meeting of the whole body was convened by circular, and by notices in this and in other scientific journals, and was held on August 7th at the Cannon Street Hotel. This meeting was very numerously attended, the subjects which called it together were fully discussed, and a number of resolutions—embodying the collective opinions of the gentlemen present—were passed.

It was decided that a "Society of Public Analysts" be formed, and a Committee was appointed to undertake the initial work connected with its formation, and to draw up a definition of "an adulterated article" (which definition we print in another column). After a number of conferences the Committee completed their allotted task, and laid the results before a general meeting, held on the 1st of December last. At this meeting a Report, submitted by the Committee, was adopted, the definition—with some slight alterations—was accepted, and a Council of the Society was elected by ballot.

As we purpose on a future occasion to recur to the subject of the definition, we will only remark here that—though it appears very simple, and might be thought to have involved but little trouble in its drawing up—the work really was an onerous one, and it was only after many conferences, and after obtaining the best assistance available, both legal and chemical, that the definition was finally drafted. It is perhaps needless to say more.

It will be understood that we shall carefully watch the introduction of the Bill promised in the coming Session, willingly supply any information we possess, and generally—as far as we may have the opportunity—"educate" our legislators on a question to which, up to now, it would be only affectation to assume that they have devoted much attention.

We have thus far only spoken of the immediate and temporary objects of the Society, but in its wider scope it will seek to embrace a mutual interchange of opinion amongst its members, a nearer uniformity of processes and results, a wider dissemination of new researches, and in every way to raise the standard of analytical work, more especially as bearing on the analysis of articles of food and drink.

Having thus, we hope, clearly defined our objects, it is, we trust, unnecessary to say that this Society does not wish to put itself in any way or degree in competition with, or to endeavour to rival, the Chemical Society, to which most of our members also belong.

As by the constitution of "The Society of Public Analysts" *all analytical chemists, but no others*, are eligible for membership, it is evident that our work, as compared with that of the Chemical Society, is very circumscribed, as we travel in a smaller circle, confining our attention to practical analyses, and leaving the more ambitious field of theoretical and speculative research to the older Society.

SOCIETY OF PUBLIC ANALYSTS.

Council of the Society.

President.—T. Redwood, Ph.D.

Vice-Presidents.—A. H. Hassall, M.D.; J. A. Wanklyn, M.R.C.S.

Treasurer.—T. Stevenson, M.D.

Other Members of Council.—Alfred H. Allen; Albert J.

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Bernays, Ph.D.; C. Estcourt; G. A. Rogers, M.R.C.S.; Francis Sutton; J. W. Tripe, M.D.

Hon. Secretaries.—C. Heisch; G. W. Wigner.

Definition of an Adulterated Article.

An article shall be deemed to be adulterated—

A. In the case of food or drink:—

1. If it contain any ingredient which may render such article injurious to the health of a consumer.
2. If it contain any substance that sensibly increases its weight, bulk, or strength, or gives it a fictitious value, unless the amount of such substance present be due to circumstances necessarily appertaining to its collection or manufacture, or be necessary for its preservation, or unless the presence thereof be acknowledged at the time of sale.
3. If any important constituent has been wholly or in part abstracted or omitted, unless acknowledgment of such abstraction or omission be made at the time of sale.
4. If it be an imitation of, or be sold under the name of, another article.

B. In the case of drugs:—

1. If when retailed for medicinal purposes under a name recognised in the British Pharmacopœia it be not equal in strength and purity to the standard laid down in that work.
2. If when sold under a name not recognised in the British Pharmacopœia it differ materially from the standard laid down in approved works on Materia Medica, or the professed standard under which it is sold.

Limits.

The following shall be deemed limits for the respective articles referred to:—

Milk shall contain not less than 9·0 per cent, by weight, of milk solids not fat, and not less than 2·5 per cent of butter-fat.

Skim Milk shall contain not less than 9·0 per cent, by weight, of milk solids not fat.

Butter shall contain not less than 80·0 per cent of butter-fat.

Tea shall not contain more than 8·0 per cent of mineral matter, calculated on the tea dried at 100° C., of which at least 3·0 per cent shall be soluble in water, and the tea *as sold* shall yield at least 30·0 per cent of extract.

Cocoa shall contain at least 20 per cent of cocoa-fat.

Vinegar shall contain not less than 3·0 per cent of acetic acid.

NOTICES OF BOOKS.

A Course of Qualitative Chemical Analysis. By W. G. VALENTIN, F.C.S., Principal Demonstrator of Practical Chemistry in the Royal School of Mines and Science Training Schools, South Kensington. Third edition. London: J. and A. Churchill. 1874.

THE former editions of Professor Valentin's work are of such recent publication, and have been so extensively used, that our readers will scarcely be ignorant of the general arrangement and scope of the book under notice. Primarily intended for the use of students who have attended Dr. Frankland's systematic lectures on chemistry, Professor Valentin naturally employs the peculiar structural formulæ which the chemists of Dr. Frankland's school especially affect. It is not every chemist, perhaps, who would feel very sure about the composition of a precipitate expressed by the formula "$P_2O(TiO_4)^{IV}TiO^{IV}$," and it is, therefore, fortunate that the author has in this case given the alternative formula, "$2TiO_2,P_2O_5$," a plan he would have done well to follow in some other cases.

The new edition presents a great advance upon the two former, in the addition of an exceedingly complete and well-arranged description of the reactions and natural sources of *all* the rare metals. We have before now expressed our opinion that the less common elements were inexcusably neglected, and hail with great satisfaction their introduction into what must be considered one of our leading works on qualitative analysis. Professor Valentin has not made the usual systematic course of analysis unnecessarily complicated by the incorporation in it of the rarer metals, but he gives abundant information for the intelligent student to detect them if present. The great improvement now introduced makes us hope for still further extension in the future. That the organic portion of almost all our works on qualitative analysis should be confined to the enumeration of some few of the organic acids, is a reflection on the present state of our methods, and, though it may not be possible to give the student concise directions for the recognition of even the commoner organic bodies when in admixture, a course of instruction in practical chemistry can scarcely be considered complete if it does not include the recognition of such common and well-defined bodies as alcohol, glycerine, sugar, and carbolic acid, when occurring unmixed and in a state of purity.

The recent proposal of the Parliamentary Committee to cause candidates for the position of Public Analysts to pass an examination at South Kensington, has made chemists curious to know the special qualifications of the authorities for holding examinations on food analysis, or for giving systematic instruction on the subject. Certainly there is nothing in the book under review calculated to remove the objections nearly universally felt, to submit to be examined in such a very exceptional and special department of applied chemistry as is food analysis.

We have observed with much pleasure the introduction by the author of various hints and remarks of considerable practical value, and we need hardly say that, in the departments of chemistry treated of, the information given is of unexceptional character, and conveyed in a very lucid and agreeable manner. We cannot but regret the omission of some of the more delicate special tests for the metals, &c., which, though seldom used, are sometimes of extreme value.

In addition to the detailed description of the methods of detecting and separating the various metals and salt radicals, there are also very complete tables for systematic analysis, and we are pleased to learn from the preface that these are now published in a separate and less destructible form, being printed on parchment-paper.

The Retrospect of Medicine. Edited by W. BRAITHWAITE, M.D., and JAMES BRAITHWAITE, M.D. Vol. lxx., July to December, 1874. London: Simpkin, Marshall, and Co.

THIS work, though rich in matter of the highest interest to the medical practitioner, presents little of chemical importance. The celebrated discussion on the alleged epidemic of typhoid in Marylebone, and its connection with milk, is not yet at an end. We certainly agree so far with Mr. Smee and his adherents, that we think the effects of milk given by cows fed upon sewage-irrigation farms, and no less vegetables manured with sewage, require careful watching.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 1, January 4, 1875.

Note on Magnetism; in reference to a Recent Communication of M. Lallemand.—Th. du Moncel.—

The author gives a fresh account of his experiments on magnetic condensation, which, from M. Lallemand's paper of October 19, 1874, he concludes are still not thoroughly known.

Decomposition and Preservation of Wood.—M. Max Paulet.—The author purposes to give an account of the destructive action which takes place in wooden railway sleepers injected with sulphate of copper. It is generally admitted that the protective action of the metallic salt is due to its combination with the ligneous tissue, and especially with the nitrogenous matter, which becomes insoluble and poisonous to living beings. This explanation is insufficient. The author has studied the action of metallic salts, and especially of sulphate of copper, upon the nitrogenous matter of wood, and finds that the albumino-cupric precipitate is not absolutely insoluble in water, and that it is especially soluble in water charged with carbonic acid. The nitrogenised matter in wood is partly soluble and partly insoluble. The soluble albuminous portion is fixed by the metallic salt, which combines also with the insoluble nitrogenous matter. The water, especially if charged with carbonic acid, dissolves and removes the metallic compound. Recent observations, however, have satisfied the author that the reactions are not always so simple. A sleeper of beech-wood, for example, saturated with cupric sulphate after having been buried in the ballast of a railway for eight or ten years, is found to be decayed in several parts. The portions affected are very brown in the vicinity of the rail. The wood is not worm-eaten, but it is chemically altered. If it no longer contains copper it contains quantities, often enormous, of iron furnished by the rail. This abundance of iron does not prevent the alteration of the timber. It has penetrated into the wood in a state of solution, since it has travelled far from the point of contact. Portions of wood which were in immediate contact with the iron, or which contained chinks into which scales of oxide of iron might have fallen, were of course set aside as not decisive. This precaution having been taken, it was established that in the layers of wood near the rail the woody fibre was brown, soft, brittle, and readily pulverised. The density of the wood was singularly diminished. Parts of the wood not attacked had the specific gravity 0·755, whilst the affected parts had fallen to 0·380. The affected wood still contains nitrogenous matter. It was entirely soluble in caustic potash, like ulmic acid. If treated with water acidulated with nitric acid it gives up to the solvent the lime which it contains, and a large amount of iron. This iron, although it must have been in a soluble state when it entered the wood, has become insoluble. Hence, ferrocyanide of potassium, applied to a ferruginous portion of this ferruginous wood does not produce a blue colouration. At the same time that nitric acid removes the iron contained in the modified wood it produces an evolution of carbonic acid, as if from an impure carbonate. This quantity of carbonic acid far exceeds what is found in wood decayed in the air. One-fourth of a gramme of the modified wood has yielded 10·5 c.c. of carbonic acid. This modified wood contains 3 per cent of ash, whilst normal beech-wood contains less than the half of this amount. Whilst boiling in the acidulated water a part of the wood dissolves. When the solution is concentrated in a platinum capsule, the residue blackens and carbonises. The parts of the sleeper more remote from the rail are less ferruginous, except in cases where the ballast is surcharged with oxides of iron; but carbonate of lime is very abundant in the affected parts. The copper gradually passes out of combination, and disappears altogether, giving place to the carbonate of lime. The process is as follows:—The carbonate of lime contained in the ballast becomes soluble in an excess of carbonic acid, penetrates gradually into the wood, and substitutes the copper. Hence, to determine the degree of the change undergone by the wood, it is sufficient to determine the quantity of carbonic acid or of carbonates present. The tenacity of the woody fibre is inversely as the carbonic acid present. As long as the copper remains in its original combination its preservative action continues. The carbonate of lime is not a septic agent, but it eliminates the preservative body from its compounds, and restores the matter to be preserved, if not to its natural state, at least to one which facilitates the access and the action of destructive agents. This confirms and explains the fact, already established by observation, that sleepers are decomposed most rapidly in calcareous soils.

Germination of Chevallier Barley.—M. A. Leclerc.—The object of this memoir is to show that when grains germinate in a limited space there does not take place, as MM. Dehérain and Landrin announced (*Comptes Rendus*, lxxviii., p. 1488), an occlusion of nitrogen gas at the outset of germination; and that the final augmentation of the nitrogen gas in experiments of long duration is due to a partial decomposition of the grain.

Letter on the Phylloxera.—M. L. Rœsler.

Expression of Work Relative to an Elementary Transformation.—M. J. Moutier.—A mathematical paper; not suitable for abstraction.

Analogies between the Escape of Gases from Supersaturated Solutions, and the Decomposition of Certain Explosives.—M. D. Gernez.—The author concludes from his experiments that there is the strongest analogy between the escape of a dissolved gas, taking place on the surface of the solution into a gaseous medium, into which the gas passes as into a rarefied atmosphere, and that decomposition of explosives which cannot, as in the case of oxygenated water, be ascribed to a particular catalytic force.

Atomic Structure of the Molecules of Benzine and Terebene.—G. Hinrichs.—This paper requires the accompanying diagrams. The author refers to his work, "Principles of Chemistry and Molecular Mechanics." Davenport: Iowa, U.S.

Titanic Ethers.—M. E. Demarçay.—Of all the titanic ethers, the only one hitherto known is the trichlorhydrin, $TiCl_3OC_2H_5$. The author has produced the hydrochlorate of monochlorhydrin, $Ti(OC_2H_5)_3Cl,HCl$.

Pyruvic Ureides; Condensed Ureides.—M. E. Grimaux.—This paper treats of dipyruvic-triureide, tetrapyruvic-triureide, and dipyruvic-tetraureide.

Aërial Corpuscles and Saline Matter in Snow.—M. G. Tissandier.—In the snow which fell between the 16th and 25th of December last, the author distinguished the presence of an abundance of foreign substances, including certain salts. The dry residue from the evaporation of a litre of snow-water was determined. Snow collected in a court yielded 0·212 grm.; from the towers of Notre Dame, 0·118 grm.; and from the country, 0·104 grm. The residue obtained on the evaporation of snow is an impalpable greyish powder, of which the organic matter, rich in carbon, burns brightly. The residual ash amounted to 57 per cent in Paris, and 61 in the country. It consisted of silica, carbonate of lime, alumina, chlorides, sulphates, nitrate of ammonia, and very appreciable amounts of iron. He suggests that a portion of the matter suspended in the air may have a cosmic origin.

Researches on the Gastric Juice.—M. Rabuteau.—The author confirms the results of Braconnot, Prout, Lassaigne, and Schmidt, showing that the acidity of the gastric juice is due, not to the lactic, but the hydrochloric acid.

Moniteur Scientifique, du Dr. Quesneville, December, 1874.

Chemical Products at the Vienna Exhibition.—M. E. Kopp.—(Continued.) An account of the pharmaceutical products, essential oils, perfumery, drugs, and raw materials for pharmacy and chemical manufactures.

According to M. Ch. Kopp, of Neufchatel, the specific gravity of different kinds of diamonds is—

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1. Ordinary crystalline diamond, for ornamental purposes	3·550
2. White diamond in natural grains	2·636
3. Black diamond in natural grains	2·653
4. Grey diamond of commerce in fragments ..	3·596
5. Black artificial diamond	3·412

Certain Properties of Weighted Black Silks.—M. J. Persoz.—The author shows that weighting—which began with the modest aim of making up the loss sustained in ungumming—is now carried to the extent of 100, 200, and 300 per cent. This increase of weight is produced by treatment with salts of iron and astringents, salts of tin and cyanides. The bulk is augmented proportionably to the weight. As a matter of course, the chemical and physical properties of the silk thus treated are materially modified. What is sold as silk is, in fact, a mere agglomeration of heterogeneous matters, devoid of cohesion, held temporarily together by a small portion of silk. The elasticity and tenacity of the fibre are sensibly reduced. From being in its natural state one of the most permanent of organic bodies, and sparingly combustible, burns like tinder if touched with flame. It is, moreover, liable to undergo spontaneous decomposition, and to absorb gases with the evolution of heat, which sometimes leads to actual combustion. The adulterated silk when burning scarcely gives off the characteristic odour of animal matter. It leaves an ash of oxide of iron, exceeding 8 per cent.

Industrial Preparation of Sulpho-Carbonate of Potash.—M. A. Gelis.—Already noticed in the Chemical News.

Applications of Indigo.—M. A. Schultz.—Reserved for insertion in full.

Titration and Assay of Manganese.—M. A. G. Pouchet.—Reserved for insertion in full.

Volumetric Determination of Copper Applicable to the Analysis of Ores, Alloys, Bronzes, and to Toxicological Cases.—M. Prosper Lagrange.—Reserved for insertion in full.

Les Mondes, Revue Hebdomadaire des Sciences.
No. 16, December 17, 1874.

M. F. Guicheteau finds that vines and trees infested by the phylloxera may be cured by driving common iron nails into the trunk.

Chalk as a Source of Heat.—M. Maridort thinks that in a common household fire lumps of chalk mixed with the coal may increase the proportion of heat utilised, though not the amount actually produced. In the furnace of a steam-boiler the addition can be only pernicious.

No. 17, December 24, 1874.

The only chemical paper in this number is an account of the manufacture of chlorine, by Mr. W. Weldon.

Reimann's Farber Zeitung, No. 47, 1874.

The editor announce that one of "our leading practical dyers" has succeeded in constructing a machine which performs all the manipulations of mordanting, dyeing, washing, &c., automatically, in the shortest possible time, and in a more trustworthy manner than the best workman.

Another discovery is a method of fixing all the aniline colours upon wool, much faster, and with increased lustre. The dye-kettles can be exhausted in one operation till clear as water, and heavy shades can be dyed in very dilute solutions. Colour is thus economised, and the inconvenience of smearing in dark shades is avoided. All blue tones can also be produced in full brightness from the redder kinds of methyl-violet.

It is further announced that an eminent chemist is in the very act of discovering the long-sought-for constitution of ultramarine—a matter which will be of the highest importance for a manufacture which has hitherto groped about in the dark.

Then follow receipts for the manufacture of artificial purpurin; for dyeing woollen knitting-yarn; for a black on woollen cloth; for a blue-green on cotton-yarn; a marine blue on silk; a black (printed) on woollen pieces and yarns; and a green and black (printing) on calico.

Liebig's Annalen der Chemie und Pharmacie.
November 9, 1874.

Contributions to the Knowledge of the Ammonia Derivatives of Benzol.—Dr. H. Salkowski.—(Second part; compounds of the benzol series.) In this paper the author treats of the trinitro compounds, including picric ether (trinitro-aniline); picric methylic ether (trinitro-anisol); the reduction of trinitro-aniline, resulting in dioxy-diamido-benzol. Passing to the dinitro compounds, he treats of experiments with the α series, the reduction of α-dinitranilin, the sulphate of tri-amido-benzol, the conversion of α-dinitranilin into dinitro-benzol; experiments in the β series, β-dinitro-anisol, the solubility of α- and β-dinitro-anisol in alcohol; β-dinitro-phenetol; β-dinitro-aniline; solubility of α- and β-dinitro-aniline in alcohol; the transformation of β-dinitro-aniline into dinitro-benzol; the mono-nitro compounds; experiments in the ortho- and para series; and decomposition of para-nitro-anisol by ammonia.

Synthesis of Methyl-Aldehyd.—B. C. Brodie.—After the gas—which the author had obtained by the action of electricity upon about equal volumes of hydrogen and carbonic acid—had been freed from carbonic oxide, carbonic acid, and traces of oxygen, there remained 191·2 volumes, which, on analysis, were found to contain 2·6 volumes of nitrogen. Deducting this, there remained 188·6 volumes, which was found to consist of—

Hydrogen	183·2
Marsh-gas	0·2
Methyl-aldehyd	5·2
	188·6

Its percentage composition is therefore—

Hydrogen	97·14
Marsh-gas	0·10
Methyl-aldehyd	2·76
	100·00

Communications from the Laboratory of Professor Wislicenus, in Würzburg.—These consist of a paper on para-di-pimalic acid, diacrylic acid, and para-di-pinic acid, by J. Wislicenus, in which we have an account of the preparation of para-di-pimalic acid from the decomposition of glycerin-iodo-propionic acid with oxide of silver; the behaviour of the para-di-pimalates at elevated temperatures; and a notice of the salts of diacrylic acid, and the reduction of para-di-pimalic acid by hydriodic acid. Next follows a memoir on the constitution of dinitro-ethylic acid, by Sylvester Zuckschwerdt; a paper on the products of the oxidation of ethyl-sulphinic acid by nitric acid, by the same author; an essay on the constitution of crotonic acid, by W. Hemilian; and a memoir by Dr. Hermann Goldenburg on the action of nascent hydrogen upon benzoin.

Remarks on the Javanese Calisaya, and on Conchinin.—O. Hesse.—The author holds that the species cultivated in Java is not the true calisaya of Weddell, but a distinct, though closely approximating species.

Communications from the Chemical Laboratory at Griefswald.—These include a memoir by Dr. M. Hayduck on ortho-amido-para-sulpho-toluolic acid, giving an account of its behaviour with concentrated sulphuric acid; the behaviour of the diazo compound of the amido acid with acetic acid, hydrated and anhydrous, and phenol, behaviour of ethyl-cresol-sulphuric acid when heated and melted with hydrate of potash; behaviour of the diazo compound with fuming sulphuric acid; nitro-ortho-brom-para-sulpho-toluolic acid; amido-ortho-brom-para-sulpho-toluolic acid; amido-para-sulpho-toluolic acid; the met

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morphoses of di-brom-ortho-amido-para-sulpho-toluolic acid; di-brom-ortho-cresol-para-sulphuric acid; the di-brom-ortho-cresol-sulphates of baryta and lime; tri-brom-para-sulpho-toluolic acid, and its baryta and lime salts; the nitro-diazo compound of di-brom-ortho-amido-para-sulpho-toluolic acid; and a paper by M. Schäfer on certain brom-amido-sulpho-toluolic acids.

Fumaric Acid and Optically Inert Malic Acid Prepared from Glyceric Acid.—A. Wesigo and Tanatar.—Fumaric acid and inactive malic acid are formed when the two atoms of chlorine in bichloro-propionic ether are replaced by carboxyl. Not a trace of succinic acid was formed.

Preparation of Chloride of Ethyl and its Homologues.—C. E. Groves.—From the *Journal of the Chemical Society*, July, 1874.

Preparation of Iodised Substitution-Products with Iodine and Oxide of Mercury.—P. Weselsky.—An appendix to the author's memoir, *Annalen*, 174, 99.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

The manufacture of paint from a black powder obtained by the utilisation of a chemical by-product or refuse hitherto considered useless, and for improved apparatus connected therewith. Robert Owen, Bowdon, Chester. April 27, 1874.—No. 1465. This invention consists, first, in the discovery that the by-product refuse or residue arising from the manufacture of prussiate of potash, and commonly called by the manufacturers animal charcoal or carbon, contains fine particles in sufficient quantities to enable a good and durable black or bluish paint to be obtained with great economy: and, secondly, in improved apparatus for effecting the separation of the particles. The residue contains ashes or gritty matters and traces of potash enveloping or mixed among the fine particles of carbon or charcoal; and these coarse and fine matters have to be separated by washing or other means for the purpose of enabling the fine particles to be used as a powder which, when worked up with boiled linseed oil and other matters used by painters, produces a black paint; bluish shades can be obtained by an admixture of any of the drugs used by dyers for the purpose of having blue tints.

Improvements in the preparation of articles to be electro-plated or coated with nickel and other metals by electricity. Henry John Brook, Edward Goodrick Draper, and John Unwin, electro-platers, all of Sheffield, York. April 29, 1874.—No. 1492. Our invention relates to and consists in the use of two certain substances, such as lime and rouge, to be used either separately or combined in preparing articles to be electro-plated or coated with nickel and other metals. We take the ordinary quick-lime and pound it very fine, and then add a certain portion of rouge, making a smooth fine powder: the same is then applied to the articles with a suitable piece of cloth or leather, carefully rubbing every part until all grease or dirt be removed from then. They are then placed in a dry state in the bath or solution to receive the deposit of nickel or other metals.

Improvements in the preparation and the electro-deposition of nickel upon metals. William Baker and John Unwin, both of Sheffield, York. April 29, 1874.—No. 1493. Our invention relates to and consists in the preparation and use of an improved solution of nickel for the purposes of the electro-deposition of that metal upon iron, copper, and other metallic and conducting surfaces. Our improved solution is composed of nickel oxide and an alkali, such as soda, potash, or ammonia, or a mixture of two or all of these alkalies, and the whole dissolved in tartaric acid; and we use the resulting solution as a bath for the electro-deposition of metallic nickel, which will produce a reguline adhesive deposit. The following are the proportions which we find convenient, namely,—100 lbs. sulphate of nickel, 53 lbs. tartaric acid, 14 lbs. caustic soda. Or we take—100 lbs. sulphate of nickel, 67 lbs. cream of tartar.

The preparation of improved materials for disinfecting and deodorising purposes. Francis Thomas Bond, M.D., Gloucester. April 30, 1874.—No. 1510. The object of this invention is to combine certain metallic and other matters, especially the sulphates or chlorides of aluminium, iron, or copper, with sawdust, so that the latter shall be saturated therewith. For certain purposes the oxides of the said metals are precipitated in and upon the sawdust by treating it, when saturated with the said salts, with ammonia; or carbolic acid is combined therewith.

Improvements in purifying the quinoidine of commerce. William Henry Maxwell Blews, manufacturer, Birmingham, Warwick. (A communication from Dr. J. E. de Vrij, Hague, Holland.) May 1, 1874.—No. 1534. This invention consists in treating the dark brown solution of the quinoidine of commerce by means of a solution of hyposulphite of sodium or other salts, whereby the solution is deprived of a dark resinous matter, and the quinoidine thus purified forms with acids very soluble compounds, which do not melt at a temperature of 212° F., and form a powder which is only very slightly coloured.

Improved manufacture of gas for heating purposes. Sir Francis Charles Knowles, Bart., Lovell's Hill, Berks. May 2, 1874.—No. 1550. This consists, first, in obtaining pure carbonic oxide by calcining limestone or chalk, and then converting into carbonic oxide the carbonic acid gas evolved; and, secondly, in mixing black oxide of manganese with charcoal of wood, or of peat, coke, or anthracite coal.

An improved method for the recovery of sulphuric acid when combined with certain chemical products. Thomas Jackson, manufacturing chemist, Clayton, near Manchester, Lancaster. May 5, 1874.—No. 1583. My invention consists in recovering sulphuric acid when combined with nitric acid, muriatic acid, benzol, naphtha, or any other coal-tar oils by means of chlorine or any other oxidising agent.

An improved composition for preserving metals from oxidation. Alberto Ara and Mario Del-Bubba, both of Florence, Italy. May 6, 1874.—No. 1595. Equal quantities of quartz and metallic oxide and a suitable solvent are employed, and after being reduced to fine powder, water is added. The mixture thus formed is applied by means of a brush to the articles to be preserved. They are then exposed to the open air to dry, and afterwards placed in muffles and heated to about 800° C.

Improvements in the preparation of caustic alkali packages. Alfred Vincent Newton, mechanical draughtsman, Chancery Lane, Middlesex. (A communication from Benjamin Talbot Babbitt, New York, U.S.A.) May 6, 1874.—No. 1601. The invention consists, first, in a ball, slab, or block of caustic alkali, hermetically sealed and protected from atmospheric influence by means of a coating or envelope of turpentine; secondly, in a process of coating packages of caustic alkali by submerging in the coating substance or composition while it is in a liquid state in a vessel in which a vacuum is produced above the liquid.

A new process of manufacturing alcohols by a methodical and endless manner with wines and fermented juices of any kind by means of new or improved apparatus suitably disposed for the purpose. Alphonse Piver, manufacturer of perfumery, Boulevart de Strasbourg, Paris. May 7, 1874.—No. 1607. In this process the temperature of the wine or fermented juices to be distilled to obtain alcohol is at once raised to a higher degree than usual in a boiler of special construction, forming the basis of a system of eliminating apparatus; the juices, heated by steam at high pressure passing through a worm within the boiler, ascend through a central pipe to the upper part of this boiler, entering a chamber forming rectifying column, from whence they run into a cooling chamber, in which the cooling liquid is wine flowing into it from an upper cistern. The vapours of the essential or empyreumatic oils produced by the heat ascend through a tube to enter a rectifying column, where the less volatile part is liquefied and collected as alcohol of bad flavour, whilst the vapours of essential oil are conveyed into a cooling chamber, where the, are condensed. The wine or fermented juices separated from the essential or empyreumatic oils in the first column of elimination, and conveyed into a cooling chamber, are conveyed from thence into a series of special rectifying columns and cooling chambers where the alcoholic vapours are condensed, and finally collected in the purest and highest quality, whilst the exhausted juices, entirely deprived of their volatile parts, are run out. The process is continuous, there being no stoppages of the distillation because of the mixing of a few drops of essential or empyreumatic oils with the alcohol, as is now the case, and the constant watching of the process is no longer necessary.

Improvements in the manufacture of soap. Alfred Vincent Newton, mechanical draughtsman, Chancery Lane, Middlesex. (A communication from Gaetano Tardani, Rome, Italy.) May 7, 1874.—No. 1614. In the manufacture of soap the patentee takes oil, or suet, or other fatty matter, and places it in a flat-bottomed iron boiler constructed in the form of a truncated cone, together with double the quantity of water, and a proportion of oxide of calcium or quicklime, rendered previously slack by means of a quantity of water. The whole must be boiled and mixed by means of a mechanical agitator.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 8th.—Medical, 8.
—— Geographical, 8.30.
—— London Institution, 5.
—— Society of Arts, 8. (Cantor Lectures.) Rev. Arthur Rigg, M.A., "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft."

TUESDAY, 9th.—Civil Engineers, 8.
—— Royal Institution, 3. E. Ray Lankester, M.A., "On the Pedigree of the Animal Kingdom."
—— Photographic, 8.
—— Anthropological, 8.
—— Society of Arts, 8. Mr. William Babington, "A General Description of the Trade on the West Coast of Africa."

WEDNESDAY, 10th.—Geological, 8.
—— Society of Arts, 8. Mr. W. Newton, "The Sandblast and its Adaptation to Industrial Purposes.

THURSDAY, 11th.—Royal, 8.30.
—— Royal Institution, 3. Professor Tyndall, "On Subjects Connected with Electricity."
—— Birkbeck Scientific Society. Mr. J. A. Barnard, "Volcanoes, Earthquakes, and other Subterranean Phenomena."

FRIDAY, 12th.—Royal Institution, 8. Weekly Evening Meeting. Mr. W. R. Greg, "Life at High Pressure." 9.
—— Royal Astronomical, 8. (Anniversary.)
—— Quekett Club, 8.
—— Society of Arts, 8. Mr. Frederick Drew, "On the Possibility of Adapting the Roman Alphabet to the Languages of India."

SATURDAY, 13th.—Royal Institution, 3 Mr. J. T. Wood, "On the Discovery of the Temple of Diana, and other results of the Government Excavations at Ephesus."

THE CHEMICAL NEWS.

Vol. XXXI. No. 794.

ON THE USE OF STANNOUS CHLORIDE AS A REDUCING AGENT IN THE TECHNICAL ASSAY OF IRON ORES, &c.

By W. F. K. STOCK, F.C.S., and W. EDWIN JACK.

In a previous communication (Chemical News, vol. xxx., p. 221), we spoke of the application of stannous chloride as a reducing agent for assay of iron ores, and the observations we then made led to a little adverse criticism by another author, who recommended the use of ammonium sulphide. Partly on this account, but more from the fact that no analytical text-book within our reach gave what we considered reliable information as to the method of working with tin-salt, we have made some careful experiments in this direction, not only in order to establish the accuracy of results yielded by it, but to show that, for rapidity of action and simplicity of detail, it stands first for its purpose in the technical determination of iron.

Referring to published information upon the use of stannous chloride as a reducer for ferric salts, we find the following objections presenting themselves, viz., the fear of adding excess of stannous salt, and the want of suitable means to prevent such excessive addition; but we have proved that, by the method of use given below, these objections no longer hold good.

In this process 1 grm. of ore is dissolved in 30 c.c. of strong HCl, or, if not decomposed by HCl, it is first fused with alkaline carbonate, and brought into HCl solution; in either case, the solution is made up to 500 c.c. with distilled water and caused to boil. The stannous chloride may now be added in small portions at a time, but it *must* be in *dilute clear acid* solution, a convenient strength containing 10 grms. of tin per litre. The colour of the ferric solution is a fair guide to the addition of the tin-salt within certain limits; but when the colour becomes faint some other indicator must be used, and this we find in a dilute, recently-prepared solution of potassium sulphocyanate, which is disposed in drops over the surface of a white tile. Special care must be taken to add the trial drops of iron solution quickly to those on the tile, and to have the beaker containing the solution in pretty close proximity to the tile, so as to guard against oxidation of solution on the glass rod with which the test drops are added. The reduction is carried so far, that only a faint tinge of pink is produced when the last addition of tin-salt has been made and allowed to boil for a few moments. The next step is the titration with potassium bichromate; and, as a vital part of the process, we make the preliminary addition of three drops of bichromate (standard solution 1 c.c.=0·01 grm. iron), then test with potassium sulphocyanate. A distinct access of colour in this test, as compared with the last test made in reducing, is accepted as proof of the absence of stannous salt, and it only remains to complete the assay in the usual manner.

We have made a large number of assays by this method, and have tested its capabilities, thoroughly comparing it with pure zinc, ammonium sulphide, sulphurous anhydride, and sodium bisulphite, and it has given us every satisfaction. It requires no filtration, no prolonged boiling to eliminate dissolved gases, and there is no fear of loss from effervescence, &c.; and we are sure that when we state that by other processes the time occupied by a reduction alone is not less than from thirty to forty-five minutes, and that by tin-salt ten minutes are sufficient for the purpose, one, and not the least, of its advantages must be evident.

It only remains for us to give some experimental proof of the accuracy of the method, and this we do by reproducing the following from our note-book.

(1). 0·3120 grm. annealed iron wire, known from analysis to contain a mere trace of foreign matter, was dissolved in HCl, treated with Cl water, boiled to expel free Cl, diluted to 500 c.c., reduced with $SnCl_2$ solution, and titrated with standard bichromate, of which each c.c. was worth 0·00997 grm. iron. 31·3 c.c. were used=0·3120 grm. iron in wire.

(2). 0·3470 grm. wire treated as above gave 0·3369 grm. iron.

(3). 0·3650 „ „ „ „ 0·36589 grm. iron.

From these results, it is evident that the process loses nothing in exactness, from the fact of the whole of the iron existing as ferric salt.

Laboratory and Assay Office, Darlington,
February 1, 1875.

LECTURES ON THE MORPHOLOGY OF CRYSTALS AT THE CHEMICAL SOCIETY.

By NEVIL STORY MASKELYNE, M.A., F.R.S., &c.

(Continued from page 26).

Lecture VI.

In his sixth lecture, Mr. Maskelyne discussed the general subject of geometrical symmetry, first in relation to a plane, and then in relation to a solid figure, and afterwards considered in what way the principles of geometrical symmetry could be applied to the symmetry of the faces, or again of the forms of crystals. A plane figure, for instance, is symmetrical to a point, that is, is centro-symmetrical when straight lines passing through the point meet at equal distances from it corresponding points of the figure. Similarly, in the case of symmetry to a line, perpendiculars on the line meet corresponding points on the figure at equal distances from the line, and the figure may be symmetrical to two or more intersecting lines. The portions of a figure symmetrical to a line will not necessarily be congruent without retroversion over the line. A solid figure, again, may be symmetrical to a centre or to a plane, or to several intersecting planes, or it may be symmetrical to a line or axis of symmetry; and such an axis may be an axis of diametral, trigonal, tetragonal, &c., symmetry. In such cases, a radius vector perpendicular to the axis of symmetry at any point upon it will meet corresponding points of the solid at equal distances from the axis as it moves in a plane perpendicular to that axis—

Through π when it is an axis of diametral symmetry.

„ $\frac{\pi}{2}$ „ „ tetragonal „

„ $\frac{\pi}{3}$ and $\frac{\pi}{6}$ in the cases of trigonal or hexagonal symmetry.

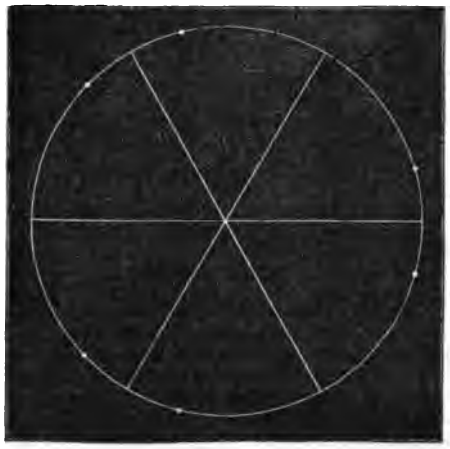
It is evident that crystals can only in a conventional sense be said to be symmetrical figures in the meaning here given to the word; but, either by considering a crystal form as an ideal figure constructed in equipoise, that is to say, with its faces parallel to the faces of the form, and with corresponding faces at equal distances from the centre, or, again, by considering the relative positions of the poles of the faces as distributed on the sphere of projection, we are in a position to deal with the symmetrical relations of crystals very much as if those natural bodies were really constructed in true geometrical symmetry.

It will be necessary, with this view, first to consider the kinds of symmetry that the faces or that the poles of a form belonging to one zone may exhibit. If there be a plane of symmetry controlling the zone, and therefore passing through its centre, it is clear that every face-normal belonging to the zone will be one of a pair of normals equally inclined on that plane; and also it will be seen, from what was previously said about the harmonic ratio, that a supplementary plane perpendicular to the first plane of symmetry will be potentially a plane of symmetry. Whether it is an actual plane of symmetry or not will depend on whether the zone is centro-symmetrical, *i.e.*, whether each normal is represented by two parallel faces at its extremities, or by only one. In the general case, however, we assume it to be centro-symmetrical.

A zone symmetrical to one plane only will be said to be euthy-symmetrically divided by that plane; where the supplementary plane is also symmetral, the zone is said to be ortho-symmetrically divided by the two planes. It is clear that, if there be more than one plane of symmetry to a zone, since each of these planes will be symmetrically repeated in respect to each other, we should have a series of consecutive planes of symmetry inclined to one another at the same angle; and, since this angle will be commensurate with π, while the planes form a group in anharmonic ratio, this angle can only be one of the four crystallometric angles, 90°, 45°, 60°, and 30°.

If now, for example, we have three planes of symmetry, a pole on the zone circle will be repeated in six poles lying

Fig. 7.

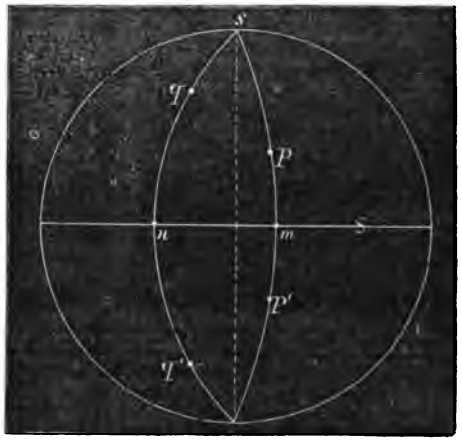


in pairs symmetrically to each plane of symmetry, as in the figure, and the zone axis will be an axis of trigonal, or rather, in this case, what will be termed di-trigonal, symmetry. If the zone be centro-symmetrical, the poles are twelve in number, and the axis has a di-hexagonal character.

Lecture VII.

We next pass on to consider the conditions involved in a plane becoming a plane of symmetry to a crystal. Here, evidently for each plane of the crystal, or, what is the same thing, for each pole of the crystal, there must exist a corresponding pole tautozonal with it and with the plane of symmetry, and equidistant with it from the circle in which the latter plane meets the sphere. Every plane of the crystal therefore lies in a zone perpendicular to the plane of symmetry, euthy-symmetrically divided by that plane; and this zone will also be potentially symmetrical to a plane perpendicular to the plane of symmetry, the pole of which will lie on the great circle of symmetry. That great circle of symmetry will then be itself a zone circle, and its pole, in which all the zone circles of the kind just considered will intersect, is also a possible pole of the crystal. Hence, for a plane to be a plane of symmetry, the necessary conditions are, that it shall be a zone plane, and also parallel to possible faces of the crystal; conditions, however, which are by no means sufficient for determining its symmetrical character.

Fig. 8.



In Fig. 8, if S is a plane of symmetry, and $p\ p'$ two poles symmetrical to it, the zone circle $[p\ p']$, and, similarly, a second zone circle $[q\ q']$, will be actually symmetrical to the plane S, and potentially also to the plane of which m is the pole; and the zone $[q\ q']$ will also be symmetrical to S and n. So m and n are possible planes, a plane of which n is the pole, and, on the assumption of centro-symmetry are actual planes, in a zone $[m\ n]$, *i.e.*, [S]; and, further, s, the pole of S, is a possible pole, since $[p\ p']$ and $[q\ q']$ are tautohedral in S.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 4th, 1875.

Professor Odling, F.R.S., President, in the Chair.

The names of the visitors having been announced and the minutes of previous meeting read and confirmed, Mr. John Mc'Dougall was formally admitted a Fellow of the Society. The names read for the first time were those of Messrs. C. T. Whitmell, B.A., T. Howard, J. W. Biggart, E. L. Fleming, J. J. Ackworth, A. Senier, M.D., F. MacKinnon, J. G. Gordon, J. W. Bell, and Captain Douglas Galton, F.R.S. For the third time—Messrs. George Turner, Robert G. H. Goffin, William Armstead, M.B., William Mc'Cowan, and David Johnson, who were then ballotted for and duly elected.

The first paper, by Mr. G. Whewell, was entitled "*Test for Carbolic Acid.*" The author states that when carbolic acid is added to concentrated sulphuric acid a bluish green ring is produced at the point of contact. A "ring" is also produced with various other acids and salts a list of which is given, whilst certain salts and acids "prevent the formation of the ring."

The President said he was sorry Mr. Whewell was not present to give further particulars as to the visible effect produced in these reactions, as it did not clearly appear what the nature of the "ring" was, which was said to be formed by the presence of certain salts and prevented by certain other salts.

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Mr. J. Williams exhibited a specimen of methyl salicy-

late or artificial oil of Gaultheria. The salicylic acid used in its preparation had been made by Kolbe's process of passing carbonic anhydride over sodium phenate heated to 230° C. In answer to a question of the President, he said that the process answered admirably when only a few ounces of the phenate were operated on, one half of the phenol distilling over, and the other half remaining in combination with the sodium as sodium salicylate; on a large scale, however, when several pounds were employed, there were difficulties arising apparently from the impossibility of maintaining the temperature constant throughout the mass. The antiseptic properties of the acid were very great; it entirely prevented fermentation in an infusion of malt, or any change taking place in milk for a considerable time.

Dr. Thudicum said there was no evidence whatever of the disinfecting power of salicylic acid. It seems to prevent the germination of fungoid growths, but it must not, therefore, be concluded that it was antiseptic or disinfectant.

Dr. Frankland observed that as it prevents the development of these lower organisms it would seem to be a disinfectant, yet its action in preventing the conversion of amygdalin into oil of bitter almonds by synaptase, would, on the other hand, seem to be a chemical one.

In reference to a remark of Dr. Stevenson on the reputed antiseptic power of boracic acid,

Mr. David Howard said he did not know what its antiseptic power might be, but boracic acid certainly destroyed vegetable growth—grass, for instance—with a vigour and permanence, which, if it were a fertiliser, would render it invaluable; he could not say what its effects were on the lower organisms.

Mr. A. Smee, Jun., had found that if 1 part of a 10 per cent solution of boracic acid were added to 8 of milk it would keep it sweet for a week.

Dr. J. Edmunds, in a complicated case of amputation of the thigh, had employed dressings of lint, steeped in a hot saturated solution of boracic acid, with most satisfactory results in preventing putrefactive discharge. The bandage could remain for 36 to 48 hours without the slightest putrefactive odour.

A note "*On the Action of Anhydrous Ether on Titanium Tetra-chloride*," by P. Phillips Benson, B.Sc., was then read. If a molecule of each of these bodies be mixed, a violent action takes place, and the liquid becomes dark brown and syrupy. On submitting it to fractional distillation a yellowish oily liquid first passes over between 105° and 120° C. This solidifies on cooling to an amber coloured crystalline mass easily decomposable by moisture. It melts between 42° and 45° C. The mean of several analyses show it to have the formula $TiCl_4(C_4H_{10})O$.

	Analyses.	Calculated.
Ti	18·54	18·79
Cl	53·17	53·39
C	17·86	18·04
H	4·03	3·75
O		6·03
		100·00

At 135°—145° unaltered titanium chloride distils over, and at 160°—172° C. a pale yellow mobile liquid, which on cooling deposits crystalline nodules, consisting of well formed opaque crystals which melt at 76°—78° C., and boil between 186° and 188° C. (corrected). The analyses show it to be titanium-ethyl-trichlorhydrin, $TiCl_3(C_2H_5O)$.

	Analyses.	Calculated.
Ti	25·16	24·88
Cl	53·44	52·85
C	11·86	11·91
H	2·75	2·48
O		7·95
		100·00

The President, in thanking the author, remarked that there were many chemists present to whom the formation of these organic bodies would be very interesting. The one might be viewed as titanium chloride, in which one of the chlorine was replaced by oxethyl; in the other the molecule was far more complex.

The last paper, "*On Dibrom-Acetic and Glyoxylic Acids*," by W. H. Perkin, F.R.S., was read by the author. After adverting to his former researches on dibromacetic acid, made in conjunction with the late Mr. Duppa, the author stated that the dibromacetic acid used in the present experiments was prepared by the action of bromine on acetic anhydride, thus avoiding the use of sealed tubes. When the silver salt of this acid is boiled with water until silver bromide ceases to be deposited, dibrom-acetic and glyoxylic acids are found in the solution in the proportions represented by the equation—

$$2C_2HBr_2AgO_2 + 2OH_2 = C_2H_2Br_2O_2 + C_2H_4O_4 + 2AgBr.$$

Silver dibrom-acetate, when heated with absolute alcohol, gave no definite results; but with dry ether a compound, $C_4H_2Br_2O_4$, seems to be formed, which may be regarded as *dibrom-aceto-glyoxylid*, since by the action of water it is resolved into dibrom-acetic and glyoxylic acids. To prepare glyoxylic acid, the author boils silver dibrom-acetate with water, separates the silver bromide formed, neutralises with argentic carbonate, and again boils. The concentrated solution, when exposed for a week or so over sulphuric acid, yields glyoxylic acid in the crystalline state as oblique rhombic prisms having the formula $C_2H_4O_4$. When heated with absolute alcohol to 120° C., it yields the compound $C_2H(C_2H_5)_3O_4$, *diethyl-glyoxalate of ethyl*. The author has also prepared the potassium, sodium, silver, and calcium salts. When calcic glyoxalate is decomposed by ammonic oxalate, or glyoxylic acid is neutralised with ammonia, a neutral solution is obtained which, when evaporated *in vacuo*, becomes acid, and ultimately yields a crystalline product having the formula $C_2H_5NO_3$ or—

$$\begin{matrix} CO.HO \\ | \\ CH.NH_2.HO. \end{matrix}$$

When calcic glyoxalate is decomposed by aniline oxalate, a clear solution is obtained, but this also quickly decomposes, becoming turbid and depositing a yellow uncrystallisable powder.

The President said that all there present interested in organic chemistry knew that the formula of glyoxylic acid was a sort of test question of great theoretical importance; but, whether we adopted the conclusions of Mr. Perkin or those of Dr. Debus, there could be no doubt of the great value of the contribution to the history of glyoxylic acid which had just been brought before them.

Dr. Debus quite agreed with the President in his remarks that Mr. Perkin has added a most valuable contribution to the history of the acid; but the question was, as to whether the formula for glyoxylic acid was $C_2H_2O_3$ or $C_2H_4O_4$. He was originally inclined to believe it to be the latter, but was ultimately led to adopt the formula $C_2H_2O_3$, for the following reasons. When alcohol is oxidised it is successively converted into aldehyde, C_2H_4O, acetic acid, $C_2H_4O_2$, and glycollic acid, $C_2H_4O_3$. The latter partook both of the alcoholic and of the acid nature, and when it lost H_2 it became glyoxylic acid, $C_2H_2O_3$, which was both aldehyde and acid. Again, in the oxidation of glycol, $C_2H_6O_2$, a body, glyoxal, $C_2H_2O_2$, was produced aldehydic in its nature, and about whose formula there was no manner of doubt. This, by oxidation, became glyoxylic acid in the following manner:—

$$C_2H_2O_2 + O = C_2H_2O_3,$$

being strictly in accordance with the fact that all acids formed from aldehydes by oxidation contain the same number of hydrogen atoms as the aldehyde from which they are derived. This was the general evidence. The direct evidence was in the ammonium salt, a definite crystalline body having the formula $C_2H(NH_4)O_3$. This compound was exceedingly decomposable, and could only be obtained by the evaporation of concentrated solutions

vacuo at a low temperature. Its aqueous solution was nearly neutral, and gave all the reactions of an ammonium salt with platinic chloride, tartaric acid, and caustic soda, similarly for glyoxylic acid. He considered that glyoxylic acid was both acid and aldehyde, and its nature might be expressed thus: $C_2H_2O_3$=COH.CO(HO). Thus all he knew led to but one conclusion, that the formula of the acid was $C_2H_2O_3$, and not $C_2H_4O_4$.

Mr. PERKIN replied that, in adhering to the formula $C_2H_4O_4$, he was more inclined to regard the facts established by the analytical results, than purely theoretical considerations. The oxidation of glyoxal into glyoxylic acid, which was instanced, took place in aqueous solution, and there was no evidence to prove that the former did not take up water when dissolved, as chloral was known to do. He had prepared the ammonium compound by neutralising the pure acid with ammonia, and evaporating *in vacuo*; but the solution, although neutral at first, always became acid, and that without any loss of ammonia, as was proved by the proportion of the nitrogen to the carbon remaining the same; a change, therefore, must take place during evaporation, which was corroborated by the behaviour of the aniline compound. If the *facts* be regarded, there was a long list of definite stable compounds in favour of the formula $C_2H_4O_4$, and not one in favour of the formula $C_2H_2O_3$, since the ammonium compound was so very unstable, and from its properties he could not regard it as a true salt. The aniline salt, also, as soon as it is formed, begins to decompose.

Dr. ODLING said, if he might venture to express an opinion, his own views were more in harmony with those of Dr. Debus than with those of Mr. Perkin.

After thanking the author for his valuable paper, the PRESIDENT then adjourned the meeting until February 18th, when there will be a lecture by Professor Clerk Maxwell, "On the Dynamical Evidence of the Molecular Constitution of Bodies."

The Faraday lecture will be delivered by Dr. A. W. Hofmann, on Thursday, March 18th.

PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

Ordinary Meeting, February 5th, 1875.

Dr. REDWOOD in the Chair.

THE CHAIRMAN, in opening the proceedings, said: Gentlemen,—You are aware that this is a general meeting of our Society, and that, in fact, it is the first of our meetings at which one of the most important objects of the Society will be introduced, viz., that of receiving communications from members relating to the subject of our respective duties as Public Analysts. I will first call upon the Secretary to read the Report of the Council.

The Report was as follows:—

"The circulars which we have addressed to you since the last meeting render it unnecessary for us to give a long report.

"In accordance with the resolution passed on December 1st, we met on December 18th, and again on the 7th January, and, after very full and exhaustive discussion of every proposal which had been made in reference to the definition, each proposition being considered separately and voted on, the definition which has been circulated was unanimously accepted as the Society's definition of an adulterated article. A considerable number of copies have been printed and circulated, and as yet the criticism which has come to our knowledge has been almost unanimous in its favour.

"We have also effected a satisfactory arrangement with Mr. Crookes for the reservation of a certain space weekly in the CHEMICAL NEWS, and our opening address is in type for this week's issue.

"It gives us great pleasure to find that our ranks are increasing, as you will see by the ballot-papers received to-day.

"The Council are paying proper care to the proceedings necessary in connection with the probable new Act, but it is unnecessary to further enlarge on this point, all necessary information on which will be given from week to week in the CHEMICAL NEWS.

"We shall be happy to receive promises of papers to be read at the next meeting."

The following gentlemen were then balloted for and elected as Members and Associates of the Society:—

Members.—John Attfield, Ph.D., F.C.S.; William Crookes, F.R.S., F.C.S.; C. W. Heaton, F.C.S; W. C. Young, F.C.S.

Associates.—Bernard Dyer; R. H. Harland; A. A. Nesbit; Charles G. Stewart; J. H. Scott.

The SECRETARY (Mr. G. W. Wigner) read the regulations adopted by the Council as to the admission of visitors and the conduct of debates.

The following paper was read by J. ALFRED WANKLYN, M.R.C.S., Vice-President of the Society:—

ON THE DETECTION OF ALUM IN BREAD.

The detection of alum in alumed bread is difficult, owing to a variety of causes. The characters of alumina are not striking, and the phosphates naturally present in bread-ash, and the minuteness of the proportion of alumina in alumed bread, tend to complicate the analysis. The quantity of alum employed in aluming bread is 20 to 30 grains to the 4-lb. loaf, and, although this proportion is occasionally exceeded, a satisfactory method for the detection of alum in bread must be able to cope with such proportions. Now, bread containing 28 grains of alum in the 4-lb. loaf contains 0·1 per cent of alum, or only 0·011 per cent of alumina. If we suppose 100 grms. of such bread to be incinerated, the ash will weigh about 1·400 grms., consisting of common salt, which forms the major portion of it, together with soluble phosphate of potash, and about 0·250 grm. of residue insoluble in water. The 0·250 grm., in this case, will be found to contain the 0·011 grm. of alumina, and the problem to be solved is, how to separate it, or its equivalent of phosphate of alumina, from the remainder of the 0·250 grm., which consists of phosphates of lime and magnesia, a little silica, and a trace of phosphate of iron. For the accomplishment of this task, a method, which is generally ascribed to Kuhlmann, is given in Watts's "Dictionary" (*vide* article, Bread). The method is as follows:—The silica having been removed by a preliminary treatment with hydrochloric acid and evaporation to dryness (by which means the silica becomes insoluble, and may be separated from the rest by filtration), the phosphates are boiled with some solution of pure caustic potash or soda, which dissolves out the phosphate of alumina, leaving the other phosphates insoluble. On filtration, there will then remain the phosphates of lime and magnesia and the trace of phosphate of iron on the filter, whilst the filtrate will contain the phosphate of alumina held in solution by the alkali. The separation of the phosphate of alumina from the alkali presents no difficulties. In carrying out this process, there is a great practical difficulty, as has, doubtless, been frequently observed by those chemists who have had occasion to employ it. The phosphate of lime forms a kind of jelly, which retains phosphate of alumina with such a degree of obstinacy that even boiling potash or soda does not avail to dissolve out a considerable proportion of the phosphate of alumina. In the case we are supposing, where the 0·250 grm. of residue insoluble in water contains 0·011 grm. of alumina (or 0·027 grm. of phosphate of alumina), there is about 0·200 grm. of phosphates of lime, magnesia, and iron, from which the alkali has to dissolve out the 0·027 grm. of phosphate of alumina. On actual

trial in the laboratory, it is found that, though the alkali is capable of removing some of the phosphate of alumina, so as to give a qualitative result, yet that a quantitative result is quite out of the question. A much more promising method of separation has been proposed by Dr. Dupré and described in the Chemical News (xxix., 233). Instead of dissolving out the 0·027 grm. of phosphate of alumina, he dissolves out the 0·200 grm. of phosphates of lime and magnesia, and leaves the phosphate of alumina and trace of phosphate of iron insoluble. The solvent employed is acetic acid, in which the phosphates of lime and magnesia are easily soluble, whilst phosphates of alumina and iron are exceedingly insoluble. In this manner, as will be understood, the mechanical difficulty is got over. This method has been submitted to a prolonged investigation in my laboratory, and the following are the particulars and results.—The quantity of bread which I operate upon is 100 grms., which, having been weighed out, is incinerated in a large platinum dish capable of holding the whole quantity at once. The incineration is managed at a comparatively low temperature, and takes some four or five hours, the platinum dish being heated by means of a large Bunsen burner, abundantly supplied with air. It is well to continue the ignition until the bread-ash is nearly completely burnt, and it is advisable to weigh the dish containing the ash. The weight of the ash should not sensibly exceed 2 grms. The ash having been obtained, is then moistened with 3 c.c. of pure strong hydrochloric acid, and then some 20 or 30 c.c. of distilled water is added, and the whole is boiled, filtered, and the precipitate washed several times with boiling water. In this manner a precipitate consisting of silica together with some unburnt carbon is left on the filter, whilst the filtrate contains the phosphates. The precipitate, which, after being burnt consists of silica, is weighed. The filtrate is mixed with 5 c·c. of liq. ammoniæ (sp. gr. 0·880) whereby it is rendered powerfully alkaline and opaque owing to the precipitation of the phosphates. It is finally mixed gradually with some 20 c.c. of strong acetic acid, and as the acid is being poured in the observation may be made that the liquid is alkaline and opaque until some 5 c.c. of acid has been added, that when about 10 c.c. has been added the liquid is acid and much clearer, and that at least 10 c.c. of strong acetic acid is added after the establishment of a distinctly acid reaction. The liquid is then boiled and filtered, and the precipitate, consisting of phosphates of alumina and iron, well washed with boiling water, ignited, and weighed. The last step is the determination of the iron in the weighed precipitate, and this is accomplished either by reduction and titration with standard solution of permanganate in the well known manner, or else by a colour-process, viz., by titration with ferrocyanide of potassium. In cases where the quantity of iron to be measured is minute, I prefer the colour-process, which will be very simple and easy of execution to all persons who are familiar with the ammonia-process of water-analysis. A few words may be devoted to the description of the process. The colour-titration of iron resembles Nesslerising, a weak standard solution of iron being substituted for the standard ammonia, and a solution of ferrocyanide of potassium for the Nessler reagent. The iron solution may be conveniently made by dissolving a gramme of fine iron wire in nitro-hydrochloric acid, precipitating with ammonia, washing the peroxide of iron and dissolving it in a little hydrochloric acid, and diluting accurately to one litre. This gives a standard solution whereof one cubic centimetre contains one milligramme of metallic iron in the condition of perchloride of iron. This standard (just as in the case of ammonia) may be diluted a hundred times to give the dilute iron solution containing $\frac{1}{100}$ milligramme of iron per cubic centimetre. The remainder of the operation closely resembles Nesslerising. The solution to be tested is put into a cylinder of clear colourless glass, and marked at 50 c.c. capacity, 1 or 2 c.c. of solution of ferrocyanide of potassium is added, and after shaking up and standing the depth of colour is observed. That being accomplished an imitation of the colour is made with standard iron, and ferrocyanide in another cylinder, and the quantity of iron required for the imitation is the quantity present in the solution under examination. The point of dissimilarity between Nesslerising and this colour-titration is, that whereas Nesslerising takes place in alkaline liquids, this titration requires that the liquid should be considerably acid, and to ensure this, every cylinder containing iron-liquids *is first made to receive one cubic centimetre of either concentrated hydrochloric acid, or nitric acid before the addition of* the ferrocyanide of potassium. I observe in a recent number of the Chemical News (vol. xxx., p. 257, December 4, 1874), a description of the testing for iron by this colour-process by T. Carnelley, B.Sc., whose observations on the subject I am able to confirm. In order to apply the titration to the mixed phosphates, it is necessary to dissolve them in acid, and it will be found convenient to dilute the solution accurately to 100 c.c., and to take $\frac{1}{10}$ for the colour titration. Having ascertained the amount of iron in the precipitate of mixed phosphates, it is only necessary to calculate it into phosphate of iron, and to subtract the weight of the phosphate of iron from the total weight of the mixed phosphates, and the difference is the phosphate of alumina yielded by 100 grms. of the bread. The following results have been obtained by applying the above-described process to samples of bread presumed to be free from alum:—

From 100 *Grammes of Bread.*

	Bread-Ash. Grms.	Silica. Grms.	Precipitate Insoluble in Acetic Acid. Grm.
A. ..	1·408	—	0·010
B. ..	1·378	—	0·006
C. ..	1·730	0·018	0·010
D. ..	1·620	0·032	0·014
E. ..	—	—	0·012*
(I.) F. ..	1·383	0·030	0·012
(II.) F. ..	1·324	0·025†	0·014

* This determination was made on 50 grms. of bread.

In the last instance the hydrochloric acid solution of the bread-ash was evaporated to dryness, and re-dissolved in order to render the silica perfectly insoluble; and, as will be seen, there was no increase in the silica, showing that, in the instance of bread-ashes, the evaporation to dryness is superfluous. Samples of A, B, C, and D were bought in the country; sample E is the bread from a West-end club; and F from a shop in Seven Dials, London. The precipitate insoluble in acetic acid contained, in every instance, a large proportion of iron, but, in some cases at least, did not consist wholly of phosphate of iron. On deducting the quantity of phosphate of iron from the total phosphates insoluble in acetic acid, there remains a residue of some 5 or 6 milligrms. It would therefore appear that unalumed bread is liable to contain a minute trace of alumina, which expressed as phosphate of alumina ($Al_2O_3PO_5$), equals 5 or 6 milligrms. per 100 grms. of bread, or 0·005 per cent. If the alum corresponding to this phosphate be calculated, it will be seen that 100 grms. of unalumed bread may appear to contain 0·022 grm. of alum; or, expressed on the 4lb. loaf, there may appear to be 6 grains of alum in it. This agrees very fairly with Dr. Dupré's observation recorded in the Chemical News. I have likewise made some experiments on bread artificially alumed in the laboratory. The sample, F, was taken, and dosed with a solution of ammonia-alum of known strength, and the following results were obtained:—As in the former experiments, 100 grms. of bread was burnt up.

	Bread Ash. Grm.	SiO_2. Grm.	Precipitate Insoluble in Acetic Acid. Grm.	Alumina added. Grm.	Or Phosphate of Alumina Grm.
I.	1·481	0·034	0·026	0·010	0·024
II.	1·538	0·029	0·041	0·020	0·048
III.	1·496	0·030	0·110	0·040	0·095

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The quantity of phosphate of iron yielded by 100 grms. of F before aluming was about 8 milligrms. After aluming and igniting there appeared to be a diminution of phosphate of iron. Possibly this diminution was owing to the chloride of ammonium derived from the alum and common salt in the bread acting on the phosphate of iron at a red-heat, and forming perchloride of iron which would volatilise. From the above it is manifest that—although there is a little irregularity in the quantities of phosphate of alumina obtained from alumed bread—still the difference between alumed and non-alumed bread is quite distinct. In investigating some samples of bread suspected of being alumed, I have found 0·039 grm. of insoluble phosphate in one case, and 0·049 grm. and 0·059 grm. in other cases. The iron present in every instance was ascertained to be very small in quantity. Besides containing alumina, alum contains sulphuric acid; and accordingly it might seem possible to follow the alum through the sulphuric acid. Unfortunately, bread-ash is naturally so highly charged with sulphates that the sulphuric acid in the alum is completely overshadowed by them, as the following experiment shows:—50 grms. of unalumed bread was mixed with 0·5 grm. of pure bicarbonate of soda, moistened with pure water, and ignited. From the ash which resulted 0·142 grm. of sulphate of baryta was obtained. 100 grms. of this bread yielded, therefore, 0·284 grm. of sulphate of baryta. This, if arising from alum, would indicate about 80 grains of alum in the 4lb.-loaf, from which the inutility of the determination of sulphuric acid in the testing of bread for alum may be appreciated. Connected with this part of the subject a point of great interest may be indicated. If no carbonate of soda be employed, and if unalumed bread be ignited, the yield of sulphate of baryta on treating the bread-ash is very much smaller, viz., about 0·150 grm. of sulphate of baryta per 100 grms. of bread, or about half as much as when carbonate of soda is taken. The explanation of this is, that a large part of the sulphuric acid found in bread-ash does not exist in the bread, but is generated during the incineration, and derives its sulphur from the gluten. In conclusion, I have furthermore to express my thanks to Mr. Nesbit, my assistant, for his careful work, which has aided me greatly in the preparation of this paper.

The Chairman—The detection of alum in bread is a subject to which Mr. Wanklyn has devoted a good deal of attention. Probably there are few better able to cope with the difficulty attending such an investigation. I shall be very happy to hear any observations from any of the members present. I am very happy to observe that Dr. Dupré, whose process Mr. Wanklyn has so prominently alluded to and so favourably spoken of, is present to-day.

Dr. Dupré—I have heard the paper with considerable interest, and I am glad to see that Mr. Wanklyn has, to some extent, simplified my process, and has, perhaps, therefore, made it more generally applicable; and I hope that after this we shall hear nothing more of the difficulty that analysts have been said to find in detecting alum, or at least alumina, in bread. However, there are a few points to which I should like to refer. The amount of alumina I found in my samples of pure bread and flour would amount to about 9 grains of alum in the 4-lb. loaf. The difference between this amount and that found by Mr. Wanklyn might be due to the difference of our manipulation. I was introducing at the time a new process, and I thought I could not take too many precautions to avoid any possibility of leaving alumina insoluble, therefore I always used the ash with alkaline carbonate, and it is not impossible that some alumina, naturally present in the bread, might have escaped without this process. We all know that clay, for example, and alumina, when strongly ignited, are not readily soluble in hydrochloric acid, and they, without fusion with alkaline carbonates, may be missed and remain with the silica. This may account for the difference between us. Well, now, as to the second point. I have dissolved the phosphate of lime; but I have never precipitated it. I have dissolved the mixed phosphates in hydrochloric acid, and have precipitated them by the addition of acetate of soda. I found that, under these conditions, boiling always threw down phosphate of lime. I always had in my phosphate of alumina some phosphate of lime. Mr. Wanklyn does not allude to this difficulty. That may be because he employs so large a quantity of acetic acid, and the strong acid causes the phosphate of lime to dissolve; but it is an important point to remember,—that, if the acid is not very greatly in excess, boiling will invariably throw down the phosphate of lime. This difficulty is entirely got over by precipitating in the cold. Even the enormous excess of phosphate of lime is got from the phosphate of alumina if the precipitation is allowed to take place in the cold. Boiling always precipitated some phosphate of lime. The experiments I made came out very accurately. I went down to 5 grains of alum in the 2-lb. loaf. I think the smallest is 10 grains in the 4-lb. loaf; and the error made does not amount to 4 grains of alum in the 4-lb. loaf. It is less than 2 grains of alum in the ordinary loaf. But I think the process, as simplified, is sufficiently accurate, and that we shall hear no more of this difficulty.

Mr. Allen—Mr. President, it is with the greatest pleasure that I have listened to Mr. Wanklyn's paper, and Dr. Dupré's very admirable remarks upon it, especially as I have been myself working a good deal recently on this subject of alum in bread, and have instituted a great many experiments, to ascertain which of the published processes was most accurate. I have prepared sets of loaves of bread, with definite amounts of alum; and I have not been content merely with calculating what the bread would weigh, but I have taken a certain definite amount of flour, and water, and salt, so as to work exactly under the same conditions, using brewers' yeast for a ferment. These loaves have been weighed, and the alum always calculated on the weight of the loaf. I have examined several processes in that way—Dr. Muter's, as published in the *Food Journal* some years ago; Dr. Dupré's, as recently published in the Chemical News; Mr. Wanklyn's, which was published in Hart's "Manual for Medical Officers of Health"; and Mr. Cleaver's, as published in the *Pharmaceutical Journal*. I may say that for some years I have been using what I may call a modification of Dr. Dupré's method, and, after considerable trouble, I have come to the conclusion that Dr. Dupré's is decidedly the best method we have at the present time; and I have obtained exceedingly satisfactory results in working it out. I have modified it slightly. I have not taken the precaution that Mr. Wanklyn has, of charring at a very low temperature. In fact, I have used a large platinum tray, and burnt it in a muffle at a very high red heat. The ash then has lost a good deal of the salt it would otherwise have contained, and, instead of getting so much as 1 per cent. I very often got less. First, the ash has been boiled with water, and the salt has been estimated in the aqueous solution. Secondly, we got an amount of insoluble ash left. The insoluble ash rises very regularly with the alum when the same sample of flour is used. I do not know how it might be with a different sample of flour. This insoluble ash, after weighing, has been fused with an alkaline carbonate. I have always added a little nitre also, dissolved the fused mass in acid, and then I have evaporated to dryness. I think Mr. Wanklyn did not evaporate to dryness. It has been then re-dissolved, and I have found it very desirable to add sulphuric acid after the evaporation. My notion was that, where there were these phosphates, there was a tendency to form volatile chloride of aluminium; and I preferred to dissolve in hydrochloric acid, and then dissolve the dried residue by means of sulphuric acid, so as to leave the bases partly phosphates and partly sulphates. This has left the silica behind, and I have tested for silica after re-fusing, and found none; but there has always been a residue. Frequently, three-quarters of the total alumina has been left in the insoluble ash when it has been dissolved in sulphuric acid in Mr. Wanklyn's and Mr. Cleaver's systems. Hydrochloric acid answers better, but cannot be trusted. I have followed Dr. Dupré, in precipitating with

acid, and using it cold or very slightly warm. I have not attempted to make any allowance for the phosphate of iron which would be precipitated; but I have always separated the iron by using pure soda prepared from sodium, and have then re-precipitated the phosphate of aluminum from the alkaline solution. In that way I have got good results. I have noticed, also, a peculiarity which is, perhaps, worth mentioning, and that is, that if you use 100 grms. of bread, the number of m.grms. of phosphate of alumina you get is almost exactly the number of grains of alum in the 4-lb. loaf—somewhere about as 39 is to 40; so that you know at once what your precipitate is. I was surprised to see London chemists making so great an allowance for the phosphate of aluminum in the bread, for I have been able only to get 2 m.grms.; and in my experience an allowance of 3 m.grms., per 100 grms. of bread, for phosphate of aluminium naturally present is amply sufficient. I would ask them, with all due deference, whether it is not possible that their flour was adulterated, because millers are in the habit of putting the alum into the flour. Unless you watch the flour in course of preparation, you do not know that the alum is not put into it, and thus added before the bread is made. I would suggest that they should analyse the grain. In the analyses of grain given by Gilbert, Lawes, and other agricultural chemists, we find no notice of alumina, and in pure flour I have not been able to find it. Mr. Horsley's method, with the logwood test, is admirable for ordinary use; I say advisedly "Mr. Horsley's method," because, although it was first proposed by Mr. Hadow, still it is, nevertheless, essentially Mr. Horsley's, in the sense that he made it systematic and really valuable. He used the alcoholic solution of logwood, into which he put an excess of carbonate of ammonia. He soaks the bread in this solution, and then, after six or seven minutes, the bread is taken out and squeezed; and bread containing even 7 grains of alum in the 4-lb. loaf distinctly shows a blue colouration. I could have brought you to-day a set of tests, with continually graduated quantities of alum added, and you could tell almost by the colour how much alum was present until you got to somewhere about 30 grains, and then the colour is so dark a blue that you cannot distinguish any further; that is the higher limit of the test, if I may so call it. I have the greatest confidence in it as a means of detecting alum; only you must not suppose, if you get the blue colouration, that there is alum necessarily present. The colouration simply means that there is something wrong. It may be carbonate of magnesia, or something else, which causes that blue colour; but still, as a means of showing that there is something wrong, the test is valuable. In those samples where there was no alum I got no blue colour. When 7 grains of alum are present in the 4-lb. loaf, this test distinctly gives a blue colour; and the colour was most distinct when the quantity was doubled. So there is no doubt about the test being exceedingly valuable, and any chemist using it will be very pleased with the result. Mr. Wanklyn has examined this question of detecting alum by means of sulphates, and, of course, has come to the conclusion that it is impossible. It has occurred to me to make use of a third constituent of alum, and see whether we could not test it by means of ammonia, for I suppose that all alum that we get commercially now is ammonia alum. I have tried this method myself, but practical difficulties have rendered it impossible. I have endeavoured to use the process of distillation and the estimation of the alum in the distillate. It is a failure in the sense that it boils over, and perhaps in pure flour you might get some ammonia developed also. Mr. Wanklyn says that from 20 to 30 grains of alum is the usual quantity used to adulterate a 4-lb. loaf. That quite agrees with my experience in another part of the kingdom; that is the usual amount which bakers use.

Dr. Muter—I think that we must all be very much obliged to Mr. Wanklyn for his very valuable paper. I think that his manner of analysis has this difficulty—That it may do comparatively well in the hands of a careful analyst; but I agree that it is, perhaps, better to evaporate to dryness in order to be sure of the insolubility of the silica, because I am afraid he would be between two fires. In the one case an analyst might ignite at too high a temperature, and then he would have to use a strong acid to separate the silica; and on the other hand, he might not dissolve all the alumina out of the ash if the ash had been burnt at a very high temperature. As far as regards the quantity of alum usually found in loaves, I must confess as another London chemist, that I agree with Mr. Wanklyn and Dr. Dupré, especially with Dr. Dupré. I have found nearly 10 grains of alum in a 4-lb. loaf of bread that was perfectly free from adulteration, and I have also examined the flour from which that bread was made. I had a curious case in reference to that. A man who was perfectly innocent of adding alum was proved to have it in his bread, and it caused a great deal of trouble, and at last we discovered that from some cause or other, the salt that he used contained a good quantity of alum, and that is how the alum had got into the bread. There were 10 grains of alum in the 4-lb. loaf, in a bread that was perfectly innocent of alum added otherwise than in the salt. As regards the logwood process, I think it bears the same relation to the matter as the permanganate of potash bears to the detection of organic impurities in water. The logwood is a sort of indication, as has been said, that the bread is not exactly simple bread, composed of flour and yeast, and so on; and perhaps the logwood test is valuable as far as it goes. As for the process I published some years ago, I may say that I have departed from it since, and I now prefer the precipitation of the phosphates by an acid in the same way as has been mentioned.

Dr. Tripe—It seems to me, Mr. President, that the chief value of the logwood test is—that if you do not get any colouration you go no farther; you do not trouble yourself to get out other results.

Mr. E. W. T. Jones—I have listened with very considerable interest to Mr. Wanklyn's paper, and to the remarks which have been made. I quite agree with Mr. Allen throughout: his remarks and his experience seem to corroborate mine absolutely. In the first place, as to the evaporation to dryness, I really do think that it is a necessity. As to the acid to be used I instituted a series of very careful experiments, and by using very strong sulphuric acid upon the ash of bread, and then heating until slight fumes were seen, and submitting it to a subsequent treatment for alumina, I was in no case able to find even a trace of alumina. I was not satisfied with the experiments as I had conducted them, but I ignited 200 grms. of bread, and I divided that ash into two parts approximately. I treated one with strong sulphuric acid, and heated it. I treated the other with hydrochloric acid, in the ordinary way. In one I obtained the alumina distinctly; in the other no trace of alumina could I detect. That clearly proved to me that it was not on ignition that I lost the alumina, although I candidly believe that unless great caution is taken—as Mr. Wanklyn observes—as to the lowness of the temperature, we lose alumina upon the ignition. As to Mr. Horsley's test, I have for some time relied upon the blue colouration, and I have never gone farther when I have found that there was no indication of the blue colour. But I should decidedly refrain from reporting any sample of bread from that test alone, and I should go farther into the matter. If I had a series of breads to test I should submit them all first to this test. I have satisfied myself that if there was no indication of colour I should not be wrong in passing them as not being alumised; and if I got a blue indication I should go farther, and prove whether it was due to alum or any other cause.

Dr. Stevenson—I, sir, can speak to the value of the method introduced by Dr. Dupré, especially with some modifications which he adopts which are not adopted by Mr. Wanklyn, particularly the re-solution of the precipitated aluminium and iron phosphate at first thrown down, and the subsequent treatment with pure soda from sodium, and its re-precipitation, which I almost invariably carry out—not exactly as Dr. Dupré does, but precipitating

the aluminic phosphate in soda, by means of acetic acid. The aluminic phosphate is thrown down by the addition of an acid. Of course it prevents the possibility of the phosphate of lime being thrown down with it. I must say, with regard to the fusion of the ash with an alkaline carbonate, I think that if you do not find any quantity of alumina in the solution obtained by hydrochloric acid it is unnecessary to fuse the ash with an alkaline carbonate. My own practice has been to obtain a solution in hydrochloric acid, and, if that contains any notable quantity of alumina, then to fuse the insoluble ash with carbonate of soda. I found, however, only very small quantities of alumina are contained in the insoluble portion of the ash, and if there is any alumina present at all, in the form of alum, you invariably get the major portion of it in the hydrochloric acid solution. I must also say that I agree with Dr. Dupré as to the quantity of alum, or rather alumina, which may naturally be found in bread and flour. I have found more than Mr. Allen finds. It is not always possible in these cases to obtain the flour from which the bread is made; but even in flour itself I have found larger quantities than he mentions, in cases in which I have been perfectly confident that there was no alum whatever in the flour. Moreover, with some of the coarser country flours, and breads made in the country, where there is less probability—from the dark colour of the bread—of its being alumed, I have found the quantity of alumina larger than in the whiter breads, which are more likely to be alumed. I think that by the use of this process the difficulties may be very greatly overcome. It only surprises one that the method is not popularly adopted. I find, however, very singularly, that the method of detecting alumina, and, I believe, of estimating alumina, by means of the phosphate, was first of all mentioned—many years ago—by a gentleman with whom I was a pupil; and I am very glad to mention it, because I observe that his son has been elected one of the associates here to-day. I refer to the late Mr. Nesbit. I believe that more than twenty years ago he proposed this method for the detection of alumina, and pointed out its extreme delicacy, though he had not developed it as Dr. Dupré has done.

Dr. Dupré—There are just a few points I should like to mention. First of all, with regard to the volatilisation of alumina by sulphuric acid. I think, if it is examined, it will be found that the alumina is left in the residue. That very point led me to the adoption of my process. I had a loaf which I had not the least doubt contained alum, and I did not detect alum in the solution, using strong sulphuric acid as solvent. I fused the insoluble part with alkaline carbonate, and, to my great pleasure, I found alumina left behind with the silica. The alumina is nothing like so soluble in the strong sulphuric acid as it is in the moderately strong hydrochloric acid. And then, with regard to the volatilisation during evaporation, I have proved, I think satisfactorily, that nothing of the kind takes place. In my original paper will be found three experiments where I took equal quantities of alum. I estimated the alumina in one portion directly; I evaporated the other two portions no less than four times with an enormous excess of the strongest hydrochloric acid, and on then estimating the alumina I found absolutely not the slightest difference in the amount between these and the first portion. Therefore, I think, this fear may be very safely dismissed. Lastly, I would say that, like Mr. Allen, I made my loaves myself; I weighed the quantity of flour, and I weighed the loaf afterwards, and, of course, made my calculations on the entire loaf. A good many years ago, when this rage against alum in bread first came up, Dr. Odling and myself made a great many observations, amongst others, on grain grown at Rothampstead, and we found very distinct traces of alumina in every one of the samples; but the quantity was so small, when expressed in percentage, that ordinary analysis entirely overlooks it.

Mr. Wanklyn—To what percentage per loaf?

Dr. Dupré—I cannot express it. It was easy to detect it. I dare say in a 4-lb. loaf it would come to several grains of alum.

Mr. Cleaver—I am afraid I can scarcely do more than corroborate the remarks already made. My process was estimating it as phosphate by means of hyposulphite of soda; and I think the only advantage is, that the hyposulphite which is precipitated is much more aggregated than the ordinary precipitate, and it can be weighed in a shorter time. You can precipitate it from the hyposulphite solution better than by using ammonia. At the end, the precipitate can be obtained in a more compact form, and be more easily weighed.

Mr. Wigner—I have for a long time used Dr. Dupré's process in the examination of bread, but I was once caught by a sample of bread which necessitated a modification of it. I had an adulterated sample which contained more than 100 grains of alum in the 4-lb. loaf calculated as alum. The phosphate present in the bread was not sufficient, and this led me always since to add a small quantity of phosphate of ammonia, which insures precipitation of the alum. I can also corroborate Dr. Dupré's figures, in reference to the amount which I have found present as the maximum in a pure bread. In pure bread or pure flour, calculated in the same proportion, the maximum I have found has been 8 grains of alum in the 4-lb. loaf, and that is the number, therefore, which I am in the habit of deducting in all my analyses.

Mr. Wanklyn—I should like to say a few words in reply. With regard to the way I alumed the bread upon which I operated, this was the process. The hundred grammes of bread was put into the platinum dish, and then the solution containing the alum was dropped on to the bread, so that there could be no doubt whatsoever of the quantity of alum that I had in that very sample of bread. That seemed to me the most satisfactory way of obtaining samples containing a known quantity of alum. With regard to the weighing of the bread ash, one of the reasons for weighing it is that it is well known that when bread is kept it alters in condition. It becomes slightly drier, and the question is sometimes asked, "Have not you operated upon exceedingly dry bread, and did not you over estimate the alum in the bread?" Now, if you take the trouble to weigh the ash, you will be able to answer that question. With regard to the solubility of silica, my reason for discarding the operation to dryness was simply this. I adopted the process, and I found that I did not get more silica when I evaporated to dryness than when I did not evaporate to dryness, and that is a very good proof that the evaporation was unnecessary. As will have been observed, I preferred to weigh the silica. The object of weighing the silica is that you are able to say absolutely whether you have or have not left any phosphate of alumina behind. If you have left phosphate of alumina undissolved, you will find it along with the silica, and the silica will be in excess. With regard to the subsequent treatment: the process that we have to adopt should be simple, and it is of the utmost importance to avoid the use of an extra reagent if you can. As will have been observed, the only reagents that I employ are hydrochloric acid, ammonia, and acetic acid. All of them are volatile substances, and, by simply ascertaining that you get no residue, you will be sure that there can have been no alumina in your reagents. As regards the volatility of chloride of aluminium, my process does not touch the question. But it is well known that, if there be traces of moisture present, there is no volatilisation. With regard to the desirableness of separating the iron I make no separation of the iron, I weigh the precipitate: then I dissolve up in hydrochloric acid, and gauge the colour of the solution. It is now pretty well known that you can detemine iron volumetrically by the colour. A short time ago there was a paper in the Chemical News, by Mr. Carnelley, giving a description of the process. I have gone over the process, and I can confirm completely everything that he has said about it. It is a most delicate process, and exceedingly simple. Well

then, if you can so easily determine the iron, if you have merely to dissolve up your precipitate, dilute, and put in a little ferrocyanide of potassium, why should you go to the trouble of making the separation?

Some other papers read at the meeting will be reported in our next issue.

CORRESPONDENCE.

RATIONAL FORMULÆ OF MORPHINE AND CODEINE AND THEIR DERIVATIVES.

To the Editor of the Chemical News.

Sir,—In Chemical News, vol. xxxi., p. 47, is a paper by Mr. S. E. Phillips, entitled "On a Study of Condensation Radicals," in the course of which the author inquires why morphine and codeine should be regarded as diamines rather than as ammonias; or, in other words, why the rational formulæ attributed to these bases should be not identical with the empirical formulæ, but multiples thereof. As similar questions have been asked by others, in reference to those morphine and codeine derivatives which I have provisionally regarded as polymerides, perhaps it may not be out of place to review here the evidence (such as it is) on which these conclusions are based, merely premising that this evidence is to be found interspersed through a series of (at present) seventeen papers communicated during the last six years to the Royal and Chemical Societies by myself, partly in collaboration with the late Dr. A. Matthiessen, and with Herr Ludwig Mayer and Mr. G. H. Beckett.

First, as to morphine and codeine. By the action of various reagents on these natural alkaloids, products can be formed the composition of which cannot be expressed by formulæ including a less number of N symbols than 2; of these products, most, if not all, can be re-transformed into the original alkaloids, thus proving that no polymerisation has taken place in the formation of these products, since, so far as I know at present, it is impracticable to obtain ordinary morphine and codeine from their respective polymerides. Hence it results that the formulæ of the alkaloids must be written as containing the N symbol at least twice, the argument being precisely analogous to that which proves tartaric acid to be bibasic, or that which fixes the formula of quinine as $C_{20}H_{24}N_2O_2$, instead of the half of this. Amongst such products may be included the following bases:—

$C_{34}H_{37}ClN_2O_5$.
$C_{34}H_{37}(C_2H_3O)N_2O_6$. .. .. Mono-acetyl morphine.
$C_{34}H_{36}(C_2H_3O)(C_4H_7O)N_2O_6$. Acetyl-butyryl morphine.
$C_{36}H_{43}ClN_2O_6$.
$C_{36}H_{43}BrN_2O_6$.

It is perfectly true that in several cases neither the base itself nor its salts have as yet been obtained crystallised. This objection to the homogeneity of the products, however, does not apply in all cases, *e.g.*, acetyl-butyryl morphine. Moreover, the assumption that these products are mixtures in equivalent quantities of morphine or codeine and a derivative of N_1 formula, is rendered highly improbable, by the behaviour of the substances with solvents, by the impracticability of separating any given product into two dissimilar constituents by the mixture of which the product can be re-formed, and by the circumstance that it is not one or two instances only that have to be dealt with, but several; so that the chance of several products being in each case mixtures of exactly equivalent quantities of two dissimilar bodies is very small.

Next, as regards the morphine and codeine "polymerides." By acting on morphine or codeine with various agents known to produce polymerising effects on other substances, a series of products are formed isomeric with the original bases, and exhibiting progressive differences in physical, chemical, and physiological action. Amongst such differences may be noticed progressive insolubility in various menstrua; progressive difficulty in crystallisation; progressive diminution in antacid characters, and in the power of receiving additive hydrogen from hydriodic acid: differences in the form in which nitrogen is evolved during certain reactions; &c.

A priori, the explanation of these results by supposing polymerisation to take place appears at least reasonable; and this view is confirmed by the circumstance that in numerous instances derivatives are obtainable from these polymerides the formulæ of which cannot be written as containing less than 4, 6, or 8 N symbols. Hence, formulæ which are multiples by 2, 3, and 4, respectively, of the formulæ of morphine and codeine are attributed to the respective members of these series of products. Not to take up space unduly, the following N_8 derivatives of the "tetra" series may be referred to as examples:—

$C_{136}H_{153}IN_8O_{20}$.
$C_{136}H_{161}IN_8O_{20}$.
$C_{136}H_{145}ClN_8O_{20}$.

In addition to these, numerous "tetra" derivatives are known the formulæ of which cannot possibly be written as containing less than 4 N symbols.

The same kind of objections and counter-arguments adduced above in reference to the ordinary (mono) codeine and morphine derivatives apply in these cases. It is not, as some have supposed, on the mere production of one or two non-crystalline, and possibly non-homogeneous, substances that the multiple formulæ are based; but on the existence of *many* derivatives of the kind referred to above, and chiefly on the consentaneous agreement of a large number of circumstances, none of which have any great weight by themselves, but which jointly are of considerable weight.

I do not pretend to have demonstrated beyond possibility of doubt the correctness of the views concerning morphine and codeine and their derivatives, to which my experiments have led me; but I may affirm that these views afford a clearer explanation and co-ordination of the observed phenomena than any others that have as yet presented themselves to me, whilst there is nothing contrary to analogy or otherwise unreasonable in them.

If I understand Mr. Phillips's last paper aright (and I am not sure that I do, owing to the somewhat *bizarre* notation which he affects), he contends that true polyamines are normally mono-acid, and that, therefore, such salts as those formed by the codeine and morphine polymerides are of exceptional character. In truth, however, polyamines are by no means always mono-acid; and, indeed, as a rule, the maximum acid-combining power of such bodies is usually equal to the number of N symbols in their rational formulæ, although a lesser acid-combining power may be sometimes manifested. Thus quinine can be either mono- or di-acid; ethylene-diamine, and analogously constituted bodies are di-acid (sometimes mono-acid also); the poly-ethylen-triamines can be mono-, di-, or tri-acid, as can also rosaniline and its phenyl, ethyl, &c., derivatives, or its homologues; the poly-ethylene-tetramines exhibit a maximum acid-combining power of 4, and so on; so that, so far from being exceptional, the salts of the morphine and codeine polymerides are quite normal, in that each of the bases fixes as many equivalents of acid or of ethyl-iodide as is indicated by the number of N symbols in the rational formula.

In conclusion, I cannot help expressing my regret that Mr. Phillips does not see his way to add greatly to the utility (not to say intelligibility) of his numerous and most laborious essays on theoretical chemistry by adopting the simple, and in many respects convenient, notation now generally used; this being based purely on experimental grounds and a few arbitrary, but convenient, conventions, and being wholly separable from any hypothesis, offers many advantages not possessed by the older systems of notation, in so far as it expresses clearly enough a large number of facts and relationships; whilst the objections that apply to the modern notation are equally applicable to the older ones, with the additional objection that the older systems are not only incapable of representing many

facts connoted by the newer one, but even sometimes misrepresent facts and are thus apt to lead to the drawing of false conclusions.—I am, &c.,

Charles R. Alder Wright, D.Sc.

Chemical Laboratory, St. Mary's Hospital, W.,
February 1, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 2, January 11, 1875.

Action of Electrolytic Oxygen on Vinic Alcohol.—M. A. Renard.—When vinic alcohol, mixed with about 5 per cent of water acidulated with one-fourth of sulphuric acid, is submitted to the current of four or five Bunsen elements, there is observed an abundant escape of hydrogen gas at the negative pole, whilst at the positive pole no gas is disengaged, the oxygen being consumed in oxidising the alcohol. After forty-eight hours, when operating upon about 100 c.c. of a mixture of alcohol and acidulated water, the experiment is concluded. The liquid has a faint amber tint. If distilled, it begins to boil at 42° to 43°, and its boiling-point gradually rises to 80° C. The distillate, treated with chloride of calcium, sends up to its surface a liquid of a powerful odour, the quantity of which increases on adding water to the saline mixture. If the liquid is submitted to fractional distillation, it yields formiate of ethyl mixed with aldehyd, and a large quantity of acetate of ethyl; but, besides these products, there are formed acetal, and a new body—monoethylate of ethyliden. These two compounds, in spite of their elevated boiling-points (88° to 90° and 104°), are nevertheless found among the first portions which distil over, by reason of their small proportion.

Stratified Light.—M. Neyreneuf.—The author, after referring to his former researches (*Comptes Rendus*, lxxviii., p. 950), undertakes to show that a regular system of oscillations is not incompatible with the propagation of a rapid flow of light and heat, capable of energetic mechanical action. The combustion of a detonating mixture is effected in a cylindrical vessel, submitted at its two extremities to the inverse actions of the positive and negative fluids: and if the successive layers receive a regular vibratory movement from the combination of the first portions of the mixture, it is clear that the flame will heat certain parts of the tube more slowly than others. If we operate with a mixture of hydrogen and oxygen, the watery vapour formed will condense by preference on the latter parts, and will thus prove that, notwithstanding the violence of the shock, the flame vibrates as it is propagated along the tube.

Specific Rotatory Power of Mannite.—M. G. Bouchardat.—The author has proved that all the derivatives of mannite which he has had the opportunity of examining, possess specific rotatory powers of variable amount, sometimes to the right and sometimes to the left. In studying these phenomena, he finds that mixed solutions of mannite and borax were unsuited to decide the question of the rotatory power of the former. There are formed, under such circumstances, true compounds, in which the properties of borax and those of mannite are completely masked. A mixture of these two bodies in equal equivalents remains soluble in water in all proportions. This liquid, unlike the solutions of borax, is not precipitated by the addition of a soluble salt either of lime or baryta. Solutions of mannite dissolve the biborate of lime, a body insoluble in water, in equivalent proportions. From the compound formed, mannite can only be extracted by treating it with a powerful acid, and extracting the residue with absolute alcohol, which removes the boracic acid. It turns the plane of polarisation strongly to the right. The specific rotatory power of the mannite in this combination = +28·6. Lastly, a capital point, if we observe solutions of mannite containing variable proportions of dissolved borate of lime, the deviations observed are sensibly as the weight of the borate in solution. On determining the rotatory power of mannite dissolved in water, the result was $[\alpha]j = -0° 15'$. Mannite is therefore an active substance having a very slight rotatory power to the left, *i.e.*, in the opposite direction to what had been concluded from experiments made with the aid of borax.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 7, 1874.

The Elasticity of Rods of Calcareous Spar.—G. Baumgarten.—An account of experiments undertaken to determine the elasticity of crystalline bodies, calcareous spar being selected for the sake of convenience. The results may be summed up as follows:—The bending of a rod is independent of the position of the lateral plane; it depends on dimensions in the same manner as in non-crystalline bodies, being directly proportional to the cube of the length, and indirectly proportional to the cubes of the breadth and thickness. There is no symmetry towards the principal axis. The minimum bending is in the direction of the corners, and the maximum in the short rhombus diagonal. It appears that all the planes of a rhombohedral primary form are tangents of the superficies of deflection along a curve. The deflections are not proportional to the weights, and the increase of the deffections becomes smaller when the weights are greater. It appears as if the linear differential equations of elasticity lost their validity in case of crystals.

Reflection of Light on the Surface of Isotropic Bodies.—G. Lundquist.—Not adapted for abstraction.

Studies on the Measurement of Terrestrial Magnetism.—Karl Braun.—(A continuation from No. vi.) This portion of the memoir treats of the determination of declination by means of the inclinatorium.

Thermo-Electricity.—Professor P. G. Tait.—From *Nature*.

Determination of the Absolute Number of Vibrations of a Note, and on the Dependence of the Height of a Note on Amplitude.—F. Poske.—A paper on acoustics: not adapted for abstraction.

Behaviour of the Hemi-Sulphide of Copper with a Solution of Nitrate of Silver.—R. Schneider.—As regards the monosulphide it seems beyond all doubt that in contact with solutions of nitrate of silver it is simply resolved into sulphide of silver and nitrate of copper. As regards the hemi-sulphide, the author could find no indications. It appeared, indeed, probable that the two compounds would be decomposed according to the equation, $Cu_2S + 2(Ag_2N_2O_6) = 2(CuN_2O_6) + Ag_2S + 2Ag$. The author found an experimental proof as follows:—0·2 grm. of very pure and finely powdered copper-glance were put in a stoppered flask along with a standard solution of nitrate of silver (0·010 grm. Ag in 1 c.c.), and subjected to continual agitation. When silver could no longer be recognised in a drop of the clear liquid, more silver solution was added until the clear liquid, after long standing, gave a faint reaction of silver, which ensued when 54·5 c.c. of the solution had been used. According to the above equation, 54·32 c.c. should have been consumed. The solution had a pale blue colour, and contained, besides the slight excess of nitrate of silver, merely nitrate of copper. It was perfectly free from sulphuric acid. The sediment when well washed was a dense, grey, crystalline, granular powder in which paler whitish particles could be plainly distinguished from others of a black colour. On treatment with nitric acid of sp. gr. 1·18, a part—metallic silver only—was dissolved with evolution of nitric oxide, whilst a homogeneous black

powder remained, having the properties of silver sulphide. Quantitative determinations proved the correctness of the above-given equation.

Remarks on the Meteorological Memoir of H. Budd.—R. Clausius.

Formation of Valleys of Glaciers.—Alex. Müller.

Rolled-Stone Ridges.—Alex. Müller.

Electrolytic Preparation of Magnets.—W. Beetz.—The author maintains, in opposition to the late Professor Jacobi, that permanent magnets may be formed by the electrolytic deposition of iron, if care be taken that the deposit is homogeneous, which may be effected by the presence of sal-ammoniac in the solution.

What Rays of Light Decompose Chlorophyll in Presence of Oxygen.—Julius Wiesner.—The author's experiments, in common with those of other observers, lead to the view that all the chemical processes connected with light in the chlorophyll granule, *i.e.*, production and decomposition of chlorophyll, and assimilation of carbonic acid and of wa' r. are produced most rapidly by the most luminous rays; .. all the visible portions of the spectrum have the power of exerting this function. The mechanical effects produced by light in plants may be chiefly ascribed to the so-called chemical rays of light.

Simple Eye-Piece Spectroscope for Stars.—F. Zöllner.—Not intelligible without the accompanying illustration.

Number of Images in Two Plane Mirrors Inclined Towards Each Other.—Dr. H. Klein.—A mathematical paper, unfit for abstraction.

Remarks on the Electrical Machine.—J. C. Poggendorff.—The author finds, in opposition to the theory of Veltmann, that a plate of thick glass in the machine of Holtz is not less efficacious than a thin plate.

No. 8, 1874.

Experimental Investigations on Electric Vibrations.—N. Schiller.—A lengthy paper; not adapted for abstraction.

Reflection of Light on the Surface of Isotropic Bodies.—G. Lundquist.—(Conclusion.) The author treats in this portion of his memoir on the reflection of light on imperfectly transparent non-metallic bodies.

Terrestrial Magnetic Measurements.—K. Braun.—This section contains directions for the determination of intensity by means of the inclinatorium, and remarks on measurements with the magnetometer.

The Magnetising Function of a Ball of Soft Iron.—Dr. C. Fromme.—Not adapted for abstraction.

Crystals of Glycerin.—V. von Lange.—The examination of these crystals was attended with difficulty, as when taken out of the mother-liquor they melt away, and render the application of the reflecting goniometer impossible. They belong to the rhombic system; their elements are $a:b:c = 1:0{\cdot}70:0{\cdot}66$; the forms are 100, 011, 101, 111. Cleavage imperfectly perpendicular to the longitudinal axis, therefore parallel to a plane 010.

Reply to the Remarks of H. Herweg on the Essay "On the Nature of Electricity."—E. Edlund.—The author refers to his work, "Théorie des Phénomènes Electriques." Stockholm: Norstedt et Söner.

Rotatory Power of the Hyposulphites.—An extract from *Comptes Rendus*, lxxvii., p. 1839.

Trinity College, Dublin.—The Board has appointed Dr. J. Emerson Reynolds to the University Professorship of Chemistry in Trinity College, Dublin. This appointment renders vacant the Professorship of Chemistry in the Royal College of Surgeons, and the Professorship in the Royal Dublin Society.

MEETINGS FOR THE WEEK.

SATURDAY, Feb. 13th.—Physical, 3. (Annual Meeting.)
MONDAY, Feb. 15th.—Medical, 8.
—— London Institution, 5.
—— Society of Arts, 8. (Cantor Lectures.) Rev. Arthur Rigg, M.A., "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft."
TUESDAY, 16th.—Civil Engineers, 8.
—— Royal Institution, 3. E. Ray Lankester, M.A., "On the Pedigree of the Animal Kingdom."
—— Zoological, 8.30.
WEDNESDAY, 17th.—Meteorological, 7.
—— Society of Arts, 8. M. Dunant, "Description of M. Kastner's New Musical Instrument, the Pyrophone."
THURSDAY, 18th.—Royal, 8.30.
—— Royal Institution, 3. Professor Tyndall, "On Subjects Connected with Electricity."
—— Royal Society Club, 6.30.
—— Chemical, 8. Professor Clerk Maxwell, F.R.S., "On the Dynamical Evidence of the Molecular Constitution of Matter."
FRIDAY, 19th.—Royal Institution, 8. Weekly Evening Meeting. Professor Frankland, "On River Pollution." 9.
—— Society of Arts, 8. (Chemical Section.) W. N. Hartley, F.C.S., "On Air and Ventilation."
SATURDAY, 20th.—Royal Institution, 3 Mr. J. T. Wood, "On the Discovery of the Temple of Diana, and other results of the Government Excavations at Ephesus.'

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THE CHEMICAL NEWS.

Vol. XXXI. No. 795.

OBSERVATIONS ON THE PRODUCTION OF NITROUS ETHER BY MEANS OF SULPHOVINIC ACID.

By Dr. T. L. PHIPSON.

A METHOD for the production of various ethers has recently been put forth by M. Champion, in which the corresponding ether-sulphuric acid is made use of. For instance, ethyl-sulphuric acid is introduced slowly into a mixture of 2 parts of concentrated sulphuric acid and 1 part of nitric acid, the vessel being kept at the ordinary temperature of the air. In the course of half-an-hour, according to the author, the liquid becomes cloudy, and the nitrous ether rises, and may be decanted off.

This method may apply tolerably well to such as the etylic alcohol, and as applied to alcohols of high atomic weights I think it is not precisely new. With regard to ethylic alcohol, I am of opinion that the process is full of danger.

Having adhered as closely as possible to the proportions indicated by the author named, I have invariably found that *nitric* ether is readily formed, not in the course of half-an-hour, but in the space of a few minutes only, and that, however slowly the sulphovinic acid is introduced into the mixture of sulphuric and nitric acids* (surrounded by cold water), and however quiet the reaction appears, there comes a moment when, without the slightest apparent cause, the whole decomposes with production of great heat and volumes of nitrous vapour, the liquid frothing up suddenly to twelve or fourteen times its original volume.

So intense is the reaction, that if the operation were conducted with large quantities of material in the hands of a manufacturer, it would probably have very serious consequences.

ON A NEW PROCESS FOR PRESERVING WOOD FROM FIRE AND DECAY.

By S. W. MOORE.

IT has been the endeavour of chemists for some long time to discover a means whereby wood could be preserved from decay and protected from fire without increasing its cost or otherwise materially altering its general properties.

The following process, devised by Mr. Weatherby and investigated by myself, seems to be one which shall meet these demands to a remarkable degree:—

The wood to be prepared is first kiln-dried, which process deprives it of all moisture and much of its volatile turpentine and other inflammable matter; it is then put into suitable cylinders, in which lime and water with sulphurous acid gas are forced into the pores of the wood under considerable pressure, the sulphurous acid being a by-product from the wasting of pyrites.

The wood is removed and dried, and is then ready for use.

When sulphurous acid is passed into lime under pressure, a sulphate of lime is formed which is soluble in water, capable of crystallising as a bisulphite, which is readily oxidisable and convertible into sulphate of lime or gypsum.

As this is an exceedingly insoluble salt, it is not easily removed, therefore, from the pores of the wood, and not only protects the wood by its presence as a non-conductor of heat, but deoxidises all matters which are likely to prove objectionable as ferments.

The advantages presented by this wood are that its weight is less after treatment than of the same wood before kiln-drying; a series of pieces gave a mean specific gravity of 0·3501. The process for working is very much cheaper than that of any other yet devised; it is an admirable means for preventing dry rot and decay from the action of water, as its pores are coated with an insoluble salt; it thus wears longer and vibrates less than ordinary pine; it resists the attacks of insects, and from the removal of the volatile inflammable matter, as well as from the introduction of a non-conducting material, it is well able to withstand fire, the interior parts not giving up gaseous matter, which always so readily inflames.

The wood, although answering these ends, contains but little matter foreign to itself.

Woody fibre	87·2
Moisture at 115° C.	8·5
Ash	4·3
	100·0

The idea here presented is much the same as that noticed accidentally in the late Franco-Prussian war; many houses there were found to have been protected from fire when they were largely built with plaster; lath and plaster walls were absolutely uninjured by the fire when surrounding parts were destroyed.

St. George's Hospital, S.W.

THE NEW DYES OF CROISSANT AND BRETONNIERE.

By ADOLPHE OTT.

A RECENT number of the *Bulletin of the Industrial Society of Mulhouse* brings a very interesting report on th ese dyes, from which we gather that a special committee has been investigating them in order to ascertain their value for the various purposes of dyeing and printing. At first the great durability of these colours engaged the attention of the members of the committee. Ink spots could, for instance, readily be removed by means of oxalic acid without the dyes themselves being changed in the least. Their exceptional affinity for the fibre was illustrated by the fact that they adhered without heating the dye-bath. It is preferable, however, to use a warm bath, one of +60° C., for instance. As mordant, bichromate of potassa may be most advantageously employed; different metallic salts yield various shades. The committee discovered further that the dyeing takes place with great regularity, and is not attended with any inconvenience such as may result with other colours from the presence of dirt on the fabric or want of sufficient bleaching.

With regard to the durability, it is stated to be of a very extraordinary kind. The sunlight, as far as observations go, seems not to exert any influence on these colours; boiling soap-solution and oxalic acid are without effect, only chlorine or hypochlorites affect or rather destroy them. According to the opinion of the committee, the shades produced by the new dye stuffs can also be obtained by the old dyes, but less easily, and they are less durable, and more expensive. Printing trials were instituted with four different colours, first with one that had been thickened with dextrine and lerocome, then with precipitated colour. The latter had been obtained by decomposing the commercial product (which in any case is the alkaline salt of a mercaptic acid, *vide Berich. der Deutsch. Chem. Gesell.*, No. 16, 1874, page 1530) by means of an acid; the precipitate was washed well, and again dissolved in caustic soda. Whether now the original colour was employed, or the one obtained in the manner indicated, it was (according to the report) mostly fixed during

* If the mixture is made in the reverse manner, decomposition occurs at once, as each drop falls.

printing; by steaming fixation was rendered more complete; the application of bichromate of potassa, however, was not necessary. If the shades obtained by dyeing are combined with those produced by printing, articles with two and three colours can be obtained.

The samples annexed to the *Bulletin* are of great beauty, and show that much can be accomplished with the new dyes that hitherto was only possible to achieve by means of the Jacquard-loom, owing to the fact that the designs show very sharp outlines, and that the colour impregnates the whole tissue.

The opinion is summed up in the following:—"The durability of the new colours confers on them an incontestable interest, and, owing to the facility with which they can be fixed, it may be expected that they will find application for certain simple goods of which great durability in colour is demanded."

With regard to the prices of the new colours, they vary from 2½ marks (1 m. = 1 sh.) to 8 marks per kilo.; the principal shades are grey, grey-brown, dark-brown, brownish-yellow, and yellow. They are at present manufactured in Goettingen and Frankfort-on-Maine.

Frankfort-on-Maine,
Feb. 8, 1875.

NEW METHOD OF QUANTITATIVE ANALYSIS OF ORDINARY ALLOYS.

By SERGIUS KERN, St. Petersburg.

THE complicated nature of the quantitative analysis of several of the best known metallic alloys demands from the operator great practice and knowledge. With the view of facilitating the labours of the operator, I annex a description of my method, which is founded on the law of reduction of metallic salts by metals, and may be applied to silver, lead, and copper alloys.

Silver Alloys.

Standard alloys of silver and copper.—English silver coin contains 92·5 per cent Ag;—French, German, Austrian, 90 per cent Ag.

Hard Silver Solder.—80 per cent Ag, 20 per cent Cu. By this method of analysis silver nitrate ($AgNO_3$) may be assayed; sometimes adulterated with potassium nitrate (KNO_3), which decreases the worth of this silver salt, so much used in electro-silvering and photography. The pure salt contains 63·5 per cent of silver. 1 grm. of filings from the coin or alloy to be analysed is dissolved in nitric acid. The whole of the solution is then carefully poured into a test-tube, and a clear copper rod is then hung in the solution. The reduced silver received is washed, dried, and weighed. Suppose, 0·4 grm. of silver is received; hence $1 : 0{\cdot}4 = 100 : x = 40$ per cent. The analysed alloy contains 40 per cent silver. If in assaying 1 grm. of $AgNO_3$, 0·5 grm. of silver was received, then $1 : 0{\cdot}5 = 100 : x = 50$ per cent. The analysed salt contains 50 per cent silver.

Lead Alloys.

Group I.—Alloys of Pb (lead) and Sn (tin). Iron solder: 50 per cent Pb, 50 per cent Sn; tin solder: 66 per cent Pb, 34 per cent Sn; tin solder, coarse: 75 per cent Pb, 25 per cent Sn. 1 grm. of the alloy is dissolved in nitric acid. The metastannic acid is filtered from the solution of lead nitrate, and boiled with hydrochloric acid. The stannic chloride ($SnCl_4$) received is reduced in metallic state by a rod of clean zinc; the solution of $SnCl_4$ must not contain free nitric acid. 0·25 grm. of tin is received: $1 : 0{\cdot}25 = 100 : x = 25$ per cent of tin; the percentage of lead is calculated by reducing the lead salt by a zinc rod.

Group II.—Alloy of lead and Sb (antimony). Printing type metal: 75 to 80 per cent Pb, 25 to 20 per cent Sb. 1 grm. of the alloy is dissolved in nitric acid. The solution containing lead nitrate, and a precipitate of meta-antimonic acid ($HSbO_3$) is filtered, and the precipitate is dissolved in strong hydrochloric acid. The antimony trichloride ($SbCl_3$) received is reduced in metallic state by a rod of clean zinc. The antimony received in a state of grey powder, and the lead obtained by reducing the nitrate of lead in solution by zinc, are weighed, and the percentage of metals in the alloy is calculated as mentioned above (see Group I).

Copper Alloys.

Group I.—Alloys of Cu (copper) and Sn (tin). Bronze: 70 per cent copper, 30 per cent tin; speculum-metal: 66·6 per cent Cu, 33·3 per cent Sn; gun-metal: 90 per cent Cu, 10 per cent Sn; bell-metal: 80 per cent Cu, 20 per cent Sn. 3 grms. of the alloy are dissolved in nitric acid. The solution containing copper nitrate and metastannic acid is filtered, and a clean iron rod is hung in the solution. The metastannic acid is reduced as mentioned above. The received metals, copper and tin, are weighed. Suppose we received 2 grms. of copper and 1 gr. of tin: $3 : 2 = 100 : x$; $x = 66{\cdot}6$ per cent copper; $3 : 1 = 100 : x$; $x = 33{\cdot}3$ per cent tin.

Group II.—Alloys of Cu (copper) and Zn (Zinc). New gold (semilor): 88 per cent Cu, 12 per cent Zn; tombac or pinchbeck: 85 per cent Cu, 15 per cent Zn; yellow brass 66·7 per cent Cu, 33·3 per cent Zn; Muntz's metal: 60 per cent Cu, 40 per cent Zn; medal-metal: 92·6 per cent Cu, 7·4 per cent Zn; good soldering brass: 72·7 per cent Cu, 27·3 per cent Zn; hard copper solder: 75 per cent Cu, 25 per cent Zn; soft copper solder: 50 per cent Cu, 50 per cent Zn. The alloy is dissolved in nitric acid, the copper is reduced, and the percentage is calculated as mentioned above. The remainder will be the percentage of zinc, which is tested in the usual manner.

Group III.—Alloys of Cu, Sn, and Zn. Soft brass for castings: 84·2 per cent Cu, 10·5 per cent Sn, 5·3 per cent Zn; hard brass for castings: 79·4 per cent Cu, 14·3 per cent Sn, 6·3 per cent Zn; tube copper: 87·8 per cent Cu, 2·5 per cent Sn, 9·7 per cent Zn; brass for turning: 73·5 per cent Cu, 4·6 per cent Sn, 22·9 per cent Zn. The alloy is dissolved in nitric acid; the solution containing nitrates of copper and zinc, and a white precipitate of metastannic acid, is filtered. The nitrate of copper and the metastannic acid are reduced into metallic state as mentioned above, and the received metals are weighed Suppose, in assaying 12 grms. of the alloy, 9 grms. o copper, and 2·5 grms. of tin were received; hence: $12 : 9 = 100 : x = 75$ per cent copper; $12 : 2{\cdot}5 = 100 : x = 20{\cdot}8$ per cent tin; the remainder, 4·2 per cent, is zinc, which can be tested in the usual manner.

I confined myself entirely to experiments on the above mentioned alloys which are most in use, but gave much attention to the analysis of silver alloys. By my method, analyses of alloys may be made without having recourse to the extensive and costly apparatus demanded by the process now in use.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 29th, 1874.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

"*On a case of Reversed Chemical Action*," by JAMES BOTTOMLEY, B.Sc.

Having observed the solubility of iodine in a solution of borax, an experiment was made to see what the result of this solution would be, expecting to obtain a combination of soda with excess of acid. 27·8475 grms. of borax were dissolved in about 250 grms. of water. As it was difficult

to anticipate what the action of the iodine might be, this element was added at hazard, the quantity used being nearly 7 grms. When assisted by heat almost the whole of this quantity dissolved in the solution, only a small quantity evaporating along with the aqueous vapour. The solution, which amounted to about 200 c.c., had only a faint yellowish tint. Being set aside for some days, it deposited crystals which proved to be ordinary borax, for 0·5932 grm. of the crystals lost by heating 0·2773 grm. of water of crystallisation corresponding to 46·75 per cent, the theoretical quantity being 47·13. After removing the crystals the solution was still further evaporated in a retort. As the evaporation proceeded, instead of the faint yellow tinge disappearing as was anticipated, the colour of the solution began to darken, finally becoming opaque owing to the quantity of free iodine in solution; vapours of iodine were also given off along with the steam. Thus the iodine which had previously dissolved and chemically united with the soda when the solution was dilute, was displaced and eliminated in the free condition when the mixture was past a certain degree of dilution. The explanation of this reversal of chemical action is as follows. When sodic borate is diluted with water its constituents are so far dissociated that the iodine acts towards the soda in the same way as it would towards caustic soda, sodium iodide and sodium iodate being the result. When, however, the solution is concentrated the boracic acid, notwithstanding its feebly acid power, is able to displace continuously and simultaneously small quantities of iodic and hydroiodic acid from combination with sodium, but these two acids cannot co-exist in the free state; by mutual reaction they give iodine and water. To test the correctness of this explanation the following experiment was made. Boracic acid was added to a solution of sodium iodide; even after boiling some time the solution only acquire a feeble yellow tint, and no iodine vapours were given off; but on the addition of sodium iodate the solution soon became dull brown owing to the presence of free iodine, which also was given off along with the steam. This behaviour of iodine with sodic borate favours the view of the decomposition of the salt by dilution; it also shows the varying character of chemical affinity under different circumstances of temperature and dilution.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

Ordinary Meeting, February 1st, 1874.

J. J. Coleman, F.C.S., in the Chair.

Mr. James Mactear, St. Rollox Chemical Works, made a short communication on "Flue-testing," promising to consider the question at greater length at a subsequent meeting. He said that the speeds of flues varied very much in all directions, vertically, horizontally, and longitudinally, and that the speed in the longitudinal direction had of late become a most interesting matter, owing to the hard and fast line which had been established by the Alkali Act, which rendered it imperative that not more than 5 per cent of the muriatic acid gas produced should be allowed to escape into the air. But the chemists in alkali works had now got a difficult nut to crack, inasmuch as the amended act stipulated that not more than one-fifth of a grain of pure hydrochloric acid for every cubic foot of air should be emitted at the top of the chimney. The Inspector had been asked to say where the samples of the gas were to be taken for testing, as it was quite impossible that the top of a very high chimney could be resorted to for the samples. That was certainly the best place for obtaining the most complete mixture of the escaping gases, but it was quite impracticable. At all other places eddies had been detected which were due to a number of varying conditions.

Mr. Mactear afterwards gave a description of apparatus which had been designed to show how hydrochloric acid gas might be distributed either into one or two condensers as might be found desirable. It is essentially a valve or damper fixed on the top of the salt-decomposing furnace, and consists entirely of stone and earthenware pipes, water being used as the luting or actual damper. There is no iron or other metal work about it. The apparatus is attached to a new double furnace at the St. Rollox Chemical Works, which is so very large that by this new arrangement, it is capable of doing three times the amount of work done by an ordinary decomposing furnace.

The apparatus was highly commended for its ingenuity and serviceableness by several speakers, and it was urged that the notice of it which would doubtless appear in the Society's "Proceedings" should be accompanied by an illustration of the damper and its connections.

Dr. James Milne then read a paper "*On the Presence of Lead and Copper in Aerated Waters*." He had found, he remarked, that some medical men in Glasgow were of opinion that lead in soda-water was not poisonous, and only recently he had had a conversation with one gentleman, who informed him that he considered the cry which had been lately raised a piece of nonsense; that lead was only poisonous when it accumulated in the system; and that, as it was sort of mild purgative, especially when taken in the morning, lead in soda-water never so accumulated. Some time ago Dr. Wallace called attention to the presence of an alarmingly large amount of lead in a sample of aërated water submitted to him for examination, and since then the whole subject had been pretty freely discussed. The presence of this metal was clearly traced to the employment of lead pipes in the machines used for the preparation of such waters, there being no doubt that water charged with carbon dioxide acts somewhat strongly on metallic lead, giving rise to the formation of carbonate of lead, which, though insoluble in water, is then held in solution, most probably as "bicarbonate," just as we find calcium carbonate dissolved in natural waters. As a result of the discussion, the use of such leaden pipes had been discontinued by the majority of the local manufacturers, pipes of block-tin being in most cases substituted, whilst, in a few cases, he believed earthenware pipes had been used. To the use of pipes made with the purest virgin tin no serious objection could, he thought, be made, except perhaps, the difficulty, in some cases, in getting them, and their high price. But it must be borne in mind that ordinary block-tin often contained appreciable quantities of lead, and that earthenware pipes, besides being very difficult to make of the forms necessary for most aërated-water machines, were also very liable to fracture. He had with him a specimen of a lead pipe taken from a soda-water machine, after being about three months in use, which quite disposed of the question of the action of aerated water on lead. Anyone acquainted with plumber work would easily understand the corrosive action which had taken place in this case—the original pipe as put into the machine being something like double the thickness of the specimen exhibited. While, however, the lead difficulty was being got over, there was another source of danger which he wished to bring under the notice of the Section, and one which, from a medical point of view, was probably of more importance than the presence of small quantities of lead—he referred to the presence of copper in such waters. The source of this contamination was, of course, easily traceable to the use of copper cylinders in the manufacture of the waters. Of course, the cylinders were previously tinned inside, and at intervals re-tinned. This, at first sight, would seem a sufficient safeguard against the introduction of copper into aërated water manufactured in such cylinders. However, in a paper recently read before the Philosophical Society, Mr. James R. Napier, F.R.S., had very clearly shown that even Loch Katrine water acted somewhat rapidly on the tinned interiors of ordinary cooking utensils—the coating of tin being gradually dissolved away. There was a machine in use in Glasgow for the manufacture of aërated

waters, in which he considered the risk of contamination from lead was quite obviated, whilst that from copper was reduced to a minimum. Of this machine Dr. Milne proceeded to give a description.

Mr. R. R. Tatlock remarked that there was much more evidence to show that a smaller proportion of lead was more injurious than a small proportion of copper. Lead was certainly a cumulative poison.

The Chairman said he would be surprised at any medical man in the city who disputed the statement that lead, in any quantity whatever, was of a dangerous nature.

Mr. Mayer was of opinion that those medical gentlemen were most unreliable advisers who entertained such a heterodox view as had been indicated in regard to the undoubtedly poisonous character of lead; and he referred to the numerous cases of lead palsy that occurred amongst painters, lead smelters, and workers in sheet lead and lead-pipe mills. Even amongst medical men there were cases of lead poisoning, owing to lead-contaminated water being used for drinking purposes.

PROCEEDINGS
OF THE
SOCIETY OF PUBLIC ANALYSTS.

Ordinary Meeting, February 5th, 1875.

Dr. Redwood in the Chair.

The second paper read was the following, by Professor Redwood, President of the Society:—

NOTE ON THE ANALYSIS OF MILK.

We are indebted to Mr. Wanklyn for the publication of a method of effecting the analysis of milk with a view to the detection of its adulteration with water, which is, I believe, adopted by most public analysts. Mr. Wanklyn has fully described his process, and the apparatus he uses in its performance in his little book on "Milk Analysis." To the public analyst this process recommends itself by its simplicity, and the facility with which the required results are obtained. I believe there is no better criterion by which to judge of the genuineness of cow's milk as supplied to the public than that which is founded on the proportion of non-fatty residue obtained by the evaporation of the milk at the temperature of boiling water. If in addition to this determination, which is the basis of Mr. Wanklyn's method of testing milk, we ascertain the specific gravity of the milk, the quantity of ash it yields, and the nature of the ash, we have all that is required for indicating the presence, and approximatively the proportion, of the common and almost the only adulterant, water. I have always adopted this method of testing milk, and have taken 9·3 parts by weight of non-fatty solids in 100 parts by measure as the assumed smallest proportion of those constituents in genuine cow's milk. This corresponds to 9 per cent by weight. Having occasion to make a large number of milk analyses, not only in my capacity of public analyst, but unofficially for several extensive milk dealers who are also cow-keepers, I am enabled to express a decided opinion, founded upon the examination of samples obtained directly from the cow, under many different circumstances as to breed, age, mode of feeding, and length of time since calving, that the standard or limit adopted by this Society is a safe and fair one. Although many of the samples I have had to examine unofficially have represented in each case the milk of a single cow, obtained under special circumstances, and intended to test the correctness of the standard adopted, I have never met with an instance in which the proportion of non-fatty solids fell below the standard I have referred to in milk obtained from a healthy cow fairly fed, and fit for the supply of so important an article of food as milk. But while 9 per cent by weight may be taken as a fair representation of the limit below which the non-fatty solids do not fall under the circumstances stated, the proportion is generally higher than this, and is often more than 10 per cent; and as the milk supplied to the public is in most cases the product of several cows, it is reasonable to expect that the limit should be generally exceeded. If it should be found that the milk supplied by a dealer was constantly close upon the limit, it would be fair to infer that some amount of dilution was resorted to, and in cases of this kind I have sometimes recommended prosecutions where the analysis only indicated a small percentage of adulteration according to the standard taken. This statement of my experience merely tends to confirm the results obtained by other analysts, and especially those of Mr. Wanklyn. Doubts have been expressed by some chemists as to the accuracy of the conclusions thus arrived at, and it is therefore desirable, and strictly in accordance with the objects of our Association, that we should encourage our members to supply any reliable analytical results bearing upon the subject. One of the objects I have in making this communication is to set an example in that direction. I have referred to Mr. Wanklyn's process for testing milk, and to the data on which an estimate of the quality of milk is founded, but while I adopt the essential features of his process, I do not obtain the results in exactly the same way as he does. The apparatus I use is different from his, and in some respects I manipulate in a different manner. I always make three experimental determinations, namely, of specific gravity, total solids, and fat, the two latter, by difference, giving the non-fatty solids. The specific gravity is taken with a carefully marked bottle at a temperature of 60° F. The evaporation of the milk is effected in a small porcelain dish heated over a water-bath, and the fat is dissolved out from the dry residue in the dish by means of ether. In ordinary cases these determinations are sufficient, but in doubtful cases, or where there is evidence of adulteration, the ash and the chlorine contained in the part of the ash soluble in water are also determined. These are the results usually obtained, and I refer to them only for the purpose of describing the apparatus I use, and explaining the method of manipulation adopted. I have sometimes as many as ten or fifteen samples of milk to test in a day, and the apparatus I use is so arranged as to admit of this or a larger number being operated upon at the same time without confusion or mistake. The water-bath I use for this purpose consists of an enamelled cast-iron bowl the diameter of which is 9 inches and its depth 4 inches, with a copper cover turned over at the rim, but not otherwise fastened to the bowl. This cover has a brass tube passing through the centre of it to within an inch of the bottom of the bowl, and terminating about 2 inches above the cover. The object of this tube is to indicate, by the escape of steam from the top of it, when the water in the bath has nearly all evaporated. Round the central tube there are five circular holes in the cover, 2 inches in diameter, to receive as many little porcelain dishes. The water-bath is supported on a cylinder of sheet iron, 7 inches in diameter and 9 inches high, with holes round the upper and lower edges of it for admission and escape of air and products of combustion, which forms, with a ring gas-burner, a convenient furnace, the heat of which can be adjusted as required. The dishes are of the best German porcelain, round bottom by preference, well and completely glazed inside and out, 2¾ inches in diameter, and 1 inch deep, with a small lip for pouring. These dishes have a capacity of about 1½ fluid ounces, and conveniently receive 200 grain measures for evaporation; each dish is carefully weighed, and the weight distinctly marked with a writing diamond near the outer rim. Each dish when in use is provided with a small glass rod, the ends of which are rounded off in the blowpipe flame. After taking the sp. gr. of the milk and entering it under the number or distinguishing mark of the sample, 200 grain measures of it are transferred from a marked pipette to

one of the dishes, the weight of which is added to the two previous entries, and as the subsequent results, up to the ash determinations, are estimated from residues left in, and weighed without removal from, the dish, liability to error from confusion of samples is avoided. During the evaporation the dishes are all easily accessible and may be conveniently placed to admit of the necessary manipulations. The milk is not allowed to dry up to a hard compact residue adhering to the dish. By means of the rod the skin that first forms over the surface, and would retard evaporation, is broken; and towards the end of the evaporation, when the residue is in a pasty state, this is broken up, granulated, and kept free from adhesion to the dish. In effecting this object, the advantage of using hemispherical porcelain dishes will be experienced, and these dishes are much more constant in weight than those made of platinum. When brought into a finely-granulated condition, the residue can be thoroughly dried without difficulty; and its complete exhaustion with ether is easily effected in the dish, the ethereal solution being decanted off into a little beaker in which the absence of any solid particles can be observed. About three or four washings with ether are sufficient, and the use of a filter quite unnecessary. After exhaustion, the residue in the dish is again dried and weighed, the loss representing the fat. If it should be thought desirable to get the ash, the last residue, transferred to a platinum capsule may be used for the purpose.

Professor Redwood, after reading the paper, exhibited and described the water-bath which he was in the habit of employing in his analyses.

Mr. Wanklyn, in inviting a discussion on the paper, said—I am sure we must all feel very much indebted to Dr. Redwood for telling us exactly how he operates. It will be understood that every chemist must operate a little differently from every other chemist. The kind of apparatus that will suit any particular chemist will depend upon his habits, to a certain extent.

Mr. Rimington—Without attempting to remark upon Dr. Redwood's process at all, I would merely state what my own practice is. I use hemispherical evaporating dishes made of glass, and I do so because glass dishes have a better lip, and the milk is more cleanly and easily poured out. We always make two separate residues—one is in a platinum dish, for the purpose of getting the ash; the other, in the glass dish, we evaporate, and take out the fat. We have no filtering, like Dr. Redwood, and we run no risk of washing any minute particles away, because the residue is perfectly dry, and from the glass dish it may be seen whether the solution is perfectly clear or not. The dish being deeper than those which have been shown by Dr. Redwood, and, having a better lip, there is less risk of loss. One of the dishes I should say would hold 3 ounces. Nothing is extracted from them, and I perceive that there is an advantage. The lip of these porcelain dishes is a little too small and too short, and it is not clear of the side.

Dr. Tripe—I think that one of the most important matters to decide would be the quantity of milk which you would take, whether it should be 100 grains or 200 grains, because there is a very considerably greater difficulty in treating 200 grains than 100, or 500 grains than 200. And I think it would be far better to settle among ourselves whether we should take 500 grains or 100. For myself, I prefer 100 grains. There is a point, also, which has just been raised which quite corresponds with my own experience, and that is, the great difficulty of extracting the whole of the fat from milk when thoroughly dry. It is much easier to get it out before it is what I call thoroughly dry, that is, when milk ceases to lose weight. I am never satisfied with the extraction until I find that there is no fatty matter remaining upon pouring any ether upon the filtering-paper. It is so very much easier to get the mass out of porcelain after evaporation than it is out of the platinum. I think it is rather questionable how far, in making a minute analysis, 200 grains may be taken by measurement rather than by weight. The specific gravity of milk varies considerably, and of course the quantity of solids varies to a considerable extent. I always weigh the milk. There is another matter which I find very handy: after scratching the weight with a diamond point on the evaporating dish, I write it over with ink, and hold it in the flame of the Bunsen and burn it. The ink is thus burnt in, and no amount of washing by soda will ever wash the mark off.

Dr. Redwood—I think that a point to be raised among the members is, whether the milk should be weighed or measured. I have adopted measuring as being more convenient than weighing.

Mr. E. T. W. Jones—I adopt the process of weighing; I think it is capable of more accuracy. I use platinum where I want the ash, but glass dishes where I want no incineration, and I use a stirrer. I pour in about 5 grms. of milk approximately, or what I think to be 5 grms. I then weigh it accurately. Then, as to the estimation of the fat, I use a large glass dish measuring about 4½ inches across, add about 10 grms. of milk, and weigh accurately. I do not evaporate quite to dryness; but before it gets to dryness I watch it and stir vigorously, so as to get it all into about the same state of dryness. I then quickly add a little ether, which, after subsidence, I can pour off perfectly clear. By using a large stirrer you are able to bring the whole of the non-fatty matter into a state of perfectly fine division, and one in which you can satisfy yourself that it is perfectly free from any fatty matter whatever. The process is clean and simple, and it appears to me that it avoids the danger that is likely to occur from loss in filtering. It has always been successful in my hands. As to taking the weight of the dishes as constant, my experience with both porcelain and glass is certainly against ever taking the weight of the dish as constant from operation to operation. I mark the weight on the dish, going only to the second decimal place, and thus get the approximate weight.

Mr. Estcourt—The statement of results seems to be an important point. According to one certificate, milk has been found adulterated with 100 per cent of water, which certificate the *Sanitary Record* cavilled at. One quart of milk which has had one quart of water added might be indicated as having 50 per cent or 100 per cent of water added, according to the two methods of calculation. It is necessary for us to decide how we shall state the quantity in presenting a certificate to persons who are not accustomed to make these calculations, and, therefore, who might justifiably imagine that one of the analysts must be wrong if two analysts state the same result in different ways.

Dr. Dupré—I invariably give my certificate stating that so much water has been added, and I usually add "Or so many pints of milk have been made into so many pints of milk and water." I do so because it is the only way which gives you a fair idea of the amount of adulteration really practised. According to what seems to be the more general plan, you say that there is 25 per cent or 50 per cent of water. Well, that apparently seems to say that in one case there is added about twice as much water as in the other,—whereas, if you state it correctly, in one case the added water is 33⅓ per cent of the original milk, and in the other 100 per cent. One man has added exactly three times as much as the other. As regards the rest I may fully corroborate the president. These dishes if they are not ignited will remain long constant. You need not, perhaps, for months trouble yourselves about any correction of the weight. As to the extraction by ether, I always let it stand over night. I can generally give them time; and then I invariably also extract them with water, and weigh the residue. I do it for the purpose of being quite satisfied myself that no other adulteration has been practised, because it might be possible that something has been added to it which you afterwards extract with water. I invariably ignite my milk in a porcelain dish. I have done it hundreds of times, and I never found any difficulty about it. The dish does vary

a little, but the variation is so small that in a milk analysis it may be entirely neglected.

Mr. Stevenson—I should like to say that the question of extraction of fat, I believe, is a matter of time. I always have found it quite unnecessary to perform the operation by stirring the milk towards the end of the process, if you only give the solid residue a sufficient soaking after it is evaporated; and indeed I prefer not to stir it and make it granular, because, when you do not stir, you obtain it in thin films, which are readily permeated by the solvents. On comparing the results obtained by long soaking and other methods, by extracting in the ordinary way, by granulating it in the mode in which our president has described, and then extracting the ether, I find that by long soakage I obtained more fat than by any other means. I find that in long soakage the petroleum spirit, or benzoline, which leaves no residue on evaporation, is an excellent solvent for this purpose: it is cheaper, more convenient, and not so volatile as ether, and admits of the warming of the residue without the fluid evaporating, and leaving the fat again in the solid form. I prefer this solvent to any other; it seems to permeate the solid residue better than any other solvent. My own practice has been, when the residue has been obtained by evaporation, to warm it twice, for about half-an-hour each time, with benzoline; then cover it well with the benzoline, and let it stand all night. That is decanted off again, and then it is soaked about five minutes in ether, and the whole dish is washed in ether, placing it over a glass vessel, so that you can see if any of the particles are dislodged. It is very rarely that such an accident occurs; if it does occur it is easily remedied, and you do not lose anything. Then dry that off in the water-bath. With regard to the statement of the results, and the question of weighing or measuring the milk, I think it is most important; and the discussion which has taken place this evening shows a confusion of ideas arising as to working by weight. We have heard Dr. Redwood speaking of 9·3 per cent of solids by weight, and we often hear that spoken of as Prof. Wanklyn's standard. Now, I believe generally that Prof. Redwood and others have taken it that his standard table was 9·3 grains of solids not fat in 100 grains of milk, volume by volume, whereas, if you look to Prof. Wanklyn's work, the 9·3 he adopts really means 9·3 by weight of solids not fat in 100 grains by weight of milk. It is so if you look in his book, so that we have had constantly in our discussions people speaking of 9·3 of solids not fat, by weight, and meaning two different things. It is exceedingly difficult to convince even an experienced lawyer's mind as to the exact meaning when you speak of grains by weight. This question has been put to me, and it is exceedingly difficult to answer:—"One hundred grains by volume of milk contains 10 per cent of solids?"—"Yes." "Does 100 grains by volume of milk weigh 100 grains by volume of water?" You are obliged to say "No," and then it is almost a hopeless case to explain that 100 grains by volume of milk and 100 grains by volume of water are of a different weight. One hundred grains by volume is only a thing which exists in our laboratories: it is not known to the public, and therefore ought not to be adopted. I invariably weigh the milk, and express the results of the solids, and the solids not fat, in grains by weight, and I think that is the only satisfactory way to state results. With regard to the statement of the percentage of the composition on our certificates, I think that the method adopted by Dr. Dupré—and his arguments have almost convinced me to-night—is a correct one: it does not appear, however, to be the one generally adopted. If you state that the milk consists of 20 per cent of water in your certificate, it is liable to the two interpretations which have been mentioned this evening. I have, for some time, altogether avoided the use of the expression "per cent;" but I state that the liquid is a mixture of milk and water, consisting of 80 parts of milk and 20 parts of added water; or, that the milk is mixed with so many parts of water. I thought that there could be no misinterpretation of my meaning: however, to my surprise, the other day a magistrate in London—one of our most experienced stipendiaries—adjourned a case because he did not understand my certificate, and he requested that in future it should be stated differently. I thought it was perfectly clear. The reason which would induce me, perhaps, in future to adopt Dr. Dupré's plan is that, when you state the amount of water added to 100 per cent of milk, the quantity of added water then is a correct guide to the proportion of water which has been added; whereas, if you state that the percentage of water in 100 parts of the mixture is so-and-so, the percentage of water forms no guide—at least, without calculation—to the amount of water which has been added.

Mr. Allen—With respect to what has been said as to the labelling of the dish, I may say that I have been in the habit of using flat-bottomed porcelain dishes, which are not glazed at the bottom outside, and I write the weight on them with a lead-pencil. It may also interest some chemists here present, although it is a little beside the subject, to say that I have given instructions to a glass-manufacturer in London to have some beakers made for me with a circle of ground glass etched on the side, by means of the sand-blast, so as to enable me to write the weight, or any label I like, on the side of the beaker, in ink or pencil, instead of sticking a paper label on. With respect to the petroleum spirit, I agree with Dr. Stevenson that it is a very convenient solvent. As to whether we should take the weight or volume of the original milk, I have been in the habit of taking the volume. At the same time I shall be inclined to take the weight in future, because the limit which we adopted recently specifies 9 per cent by weight. I therefore prefer to do it by weight. I have always been in the habit of taking the original gravity, so that it would give me the means of calculating exactly from the 10 centimetres which I employ to the corresponding weight. As to the method of stating the proportion of water, though I quite agree with much that Dr. Dupré has said, I think that it is met by saying that the milk is adulterated by so much per cent of water, or so as to make 8 gallons of original milk into 10 gallons of milk and water, assuming 20 per cent of water. It certainly would have an advantage if we were to say that every 100 volumes of the original milk has been adulterated with 25 per cent of water, so as to make 8 gallons into 10: that is, practically, 80 made into 100. I quite agree with those who say that it is necessary to humour the magistrates, because they are apt to misunderstand unless it is put clearly before them; and we suffer very much from misinterpretation of all sorts, without leaving anything else open to be misunderstood. With respect to taking the gravity of the original milk, I always intend to do so, for the purpose of disproving the remarkable statement that was made by a gentleman reading a paper in public, in the course of last year, that a milk purposely adulterated with water would always have an original gravity of less than 1·025.

Dr. Tripe—I recently obtained a specimen of very rich milk; I skimmed it, added water to it, and got a higher specific gravity when I had added 25 per cent of water. The specific gravity of milk which had three-fourths of the cream taken away was 1·031. I just merely mention that to show the utter futility of depending in any way whatever upon specific gravity. As to this question of the form of the certificate, I always have put it "Adulterated with so much of added water." If 20 per cent, I say "One-fifth added water," and not "20 per cent." If it is 25 per cent, I say "One-fourth of added water." They understand that perfectly well. That there may be no mistake as to the percentage, I put also, in brackets, "25 per cent," or whatever it may be, besides putting in plain English "Adulterated with one-fourth."

Mr. Rimmington—As we are telling our experiences, it is just as well that we do tell them clearly and honestly. It appears that it is common in London to state the result

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of the analysis on the certificate. The Act does not require it. The Act says that the analyst shall say whether it is adulterated or is not, and, if it is adulterated, whether it is injurious to health. That is all that the Act requires, and I am advised to say no more than what is just necessary, leaving the rest to come out in evidence. This is a hint which, if it is adopted, you will find will save a great amount of trouble. If you begin to state the result of the analysis upon the certificate, you get a number of questions put to you which it is not always very easy to answer.

Mr. Wanklyn (the Chairman)—Before calling upon Dr. Redwood to reply, I should like to make one or two remarks. As is well known, I employ platinum vessels. These vessels are not so constant as glass or as porcelain, but they are sufficiently constant for the purpose. The reason why I think that platinum is preferable to porcelain or glass is that it is cold almost the moment that it is taken out of the bath, and you save a great deal of time by working in platinum. In the year 1871 I had occasion to make a great many hundred milk analyses, and I had more than a thousand made for me. As you may imagine, it was all-important to me to ascertain what would save time, and the little modifications that I have adopted have many of them for their object to save time without sacrificing accuracy. With regard to the mode of stating results, I was aware of the possible confusion when I wrote my little book, and I devoted a chapter to explaining the two methods of statement. There is percentage, which, I think, everybody understands, which is that 100 parts by weight yield so and so; and there is the other form. Now, to avoid any confusion, I keep to the French weights. There is the percentage form, and there is the volume form. The volume form is—"100 cubic centimetres contains so many grammes." That is perfectly unambiguous, and if you wish to reduce that to percentage you calculate on 103. One hundred cubic centimetres of average milk weighs 103 grammes, or so nearly so that the difference makes no matter. With regard to the giving of certificates, the form I use is a duplicate statement. I state the composition of the sample:—"This sample of milk contains so much milk and so much water, or it was made by adding so much water to so much milk," so that the magistrate can choose the form in which he likes to regard the certificate.

Dr. Redwood—I have very few words to say in reply to the discussion. I am very glad to find that the few very unimportant points that I brought before the meeting have led to a much more important discussion. My reply will have reference to very few points. One is with regard to the little porcelain dishes which I use. I have been asked by one or two as to whether I am quite correct in indicating the simple amount of alteration that takes place in their weight after long and habitual use. I beg to observe that, in order to insure their almost complete invariability in weight, it is necessary to carefully select the dishes, and to see that they are glazed over the upper surface as completely as possible. It will be found that some of them have a rough edge, and those are the dishes that will alter most in weight. I must say that I should expect that dishes such as Mr. Allen has referred to, not glazed at the bottom, would be subject to that defect, and to another defect also; because I find that, where the glaze does not completely cover the porcelain, not only does abrasion take place there, but absorption of moisture also; and with the dishes I use, in a water-bath, it is very difficult to keep them in a perfectly uniform condition in that respect. But when a good selection of dishes has been made, and they are not continued in use after they become roughened upon the upper surface, I certainly do find that they vary very little indeed in weight. I have stated that a variation to the extent of a hundredth of a grain in the weight of the dish—which ranges from about 350 to 450 grains—is as great a variation as I generally find to occur after a lapse of several months. One other point relates to the solvent used for taking out the fat. I use ether, not because I consider ether a better solvent than benzoline would be, and certainly not a cheaper solvent; but methylated ether answers the purpose perfectly well. The cost is not a material matter as regards the quantity used, and I prefer to use ether mainly because—where the question arises as to how the fat has been taken out—ether is a more definite body than if we have to speak of benzoline or benzole, or any body of that description. But the benzolines, especially, are extremely complicated, and some little doubt or difficulty may arise from that cause.

Some Recent Adulteration Cases.

From a number we select a few, each of which we think has some point of interest to the analyst.

At Greenwich Police Court two grocers were convicted, on the certificates of Mr. Wigner, of selling caper tea, containing siliceous matter in the respective proportions of 7 and 8 per cent. The magistrate stated that the defendants were "strictly liable for selling the article adulterated," but from "his experience in China" he had no doubt that the sand or quartz arose from dust accidentally blown on to the tea when in the process of drying. He therefore imposed no fine, but ordered the defendants to pay 2s., cost of summons. This decision appears to have given great satisfaction to the grocers, and a paper specially advocating their interests devotes a leading article to the case, under the heading "Common Sense from Greenwich."

At the Thames Police Court a cowkeeper was summoned for selling adulterated milk, Professor Anderson certifying that 9 per cent of water had been added. Dr. Tidy, however, certified that he had examined a portion of the same sample, and he considered it pure. The magistrate eventually dismissed the case, and granted the defendant £2 costs. It would be as well, in cases such as these, if each analyst would give the figures upon which he arrives at his conclusions, as in the absence of these data it is impossible to decide between the conflicting testimony.

As illustrating the different views held by different magistrates as to the culpability of adulteration, we may mention two very recent milk cases, in both of which convictions were obtained and penalties inflicted, but in strangely varying proportion.

At Woolwich a dairyman was convicted of adding 16 per cent of water to his milk. The magistrate admitted that he was compelled to convict him, but affirmed his belief that the defendant was "a respectable man who would not defraud the public," and to express his opinion he inflicted a fine of *half-a-crown*, and two shillings costs.

At the Salford Police Court, another dairyman was convicted of adding 29 per cent of water to his milk, and was promptly fined *twenty pounds* and costs, without even the alleviating accompaniment of an expression of magisterial regret.

It would almost appear, from these two cases, as if geography must have something to do in determining the relative criminality of persons selling adulterated articles, as what is clearly quite a venial offence in Kent becomes rather a serious matter in Lancashire.

"*The Sale of Food and Drugs Act*, 1875."

The new Adulteration Act, bearing the above title, was introduced into the House of Commons last Friday by Mr. Sclater Booth, and the second reading was fixed for this day (Friday). The clauses of the Act are not yet made public, but it is understood that its general purport is to repeal all the previous Acts, and replace them by one Act applying to England only, leaving Scotland and Ireland to be separately legislated for. A special provision is expected to be made for examination of tea in bond. Provision will also be made for exemption of labelled mixtures, and a penalty will be imposed on dealers refusing to supply the inspectors.

Next week we hope to give a report of the proceedings in the House.

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NOTICES OF BOOKS.

Proceedings of the American Pharmaceutical Association at the 21st Annual Meeting. Philadelphia: Sherman and Co.

This bulky volume, extending to upwards of 700 pages is a proof of the energy and activity of the Association by which it is issued.

As is necessarily the case with publications issued only annually, the majority of the chemical facts mentioned are no longer novel by the time the work can reach our hands. Nevertheless it is a great convenience for pharmaceutists to have all discoveries bearing upon their profession collected together in a form suitable for reference. We are struck with directions for preparing oxygen from chlorate of potassium "from which woody particles have been carefully removed." Surely it is gross carelessness on the part of manufacturers to send out chlorate of potash contaminated in this manner. The report on the adulteration of drugs and chemicals brings to light some interesting facts. Gum benzoin was found adulterated with hemlock-bark. Worthless cinchona barks are sometimes sprinkled with an alcoholic or acetic solution of quinoidin. Cacao butter is made up with wax and cocoanut oil. The only pure mustard in commerce is stated to be Früauf's, from Russia. The finest mustard in the world is produced on the lower Wolga. Castor oil has been found containing 5 per cent only of the genuine matter, the residue being whale-oil. Linseed oil and refined rape-oil are sophisticated with rosin oil. An American company have been circulating advertisements of a certain "neutral oil" for the express purpose of "manipulating" lard oil, raw and boiled linseed, refined cotton-seed oil, and castor oils. "It will enable you" says the circular "to make large profits on articles that heretofore hardly paid to handle." "Handling" and "manipulating" are polite words which adulterators on both sides the Atlantic use in speaking of their thievish operations. An article sold as sulphate of ammonium proved to be the sulpho-cyanide, and was, of course, very destructive to vegetation. As much as 25 per cent of sawdust has been found in iodine. The editors hope that this may be rather an accident than a fraud. Iodide of potassium may contain 9 per cent of bromide. Bromides have been found with 35 per cent of impurities, carbonates, sulphates, chlorides, and iodides. Chocolate has been found to contain powdered cantharides, an admixture employed doubtless for criminal purposes. The use of poisonous colours in ornamenting confectionery, and in getting up papers in which articles of food are developed is stated to be on the increase. We beg to call the attention of our public analysts to this mal-practice, and we hope that it will not escape the notice of Government.

Dried willow leaves are now extensively used for the adulteration of tea. According to Consul Medhurst more than 53,000 lbs. of these leaves were in preparation in Shanghai at one time.

These few extracts, which might be greatly extended, will show the highly valuable character of the volume.

Assaying by the Spectroscope Experiments made in the U.S. Mint. Philadelphia.

The interesting memorandum of Mr. W. Chandler Roberts, chemist to the Mint, pointing out that he was engaged conjointly with Mr. J. Norman Lockyer in examining the application of the spectroscope to the quantitative analysis of alloys of the precious metals has excited much attention. The authorities of the United States Mint instructed Mr. A. E. Outerbridge, an assistant in their Assay Department, who had given special attention to spectroscopy, to submit this new mode of analysis to a careful examination, and to ascertain its possibilities. The pamphlet before us contains the results obtained by the experimentalist as described in two letters addressed by him to his official superior, Mr. W. E. Du Bois, Assayer of the Mint, and communicated by the latter with a few introductory remarks to the American Philosophical Society (May 15, 1874).

These results, we regret to say, are not encouraging. One of the greatest obstacles encountered is "the natural and necessary imperfection of metallurgy, the want of complete atomic homogeneity in the mixing of the metals" which, as the reporter fears "will for ever prevent the spectroscope from taking the place of the present methods of assay." The quantity of metal vapourised and giving the spectrum seems too infinitesimal to give safe results for a large melt, as it must be affected by the least want of homogeneity in the metal. How difficult such perfect homogeneity is to attain may be learned from the valuable memorandum of Mr. Chandler Roberts on the preparation of new standard plates for the British Mint. The amount of gold consumed in furnishing a spectrum, Mr. Outerbridge estimates as follows:—An electrode loses $\frac{1}{1000}$ of a grain after passing 3000 sparks, or for 1000 sparks $\frac{1}{3000}$ of a grain, or for each spark $\frac{1}{3000000}$ of a grain. "The exceedingly small quantity of metal thus assayed," he continues "renders this process, to my mind, inapplicable to the operations in the Mint; for it is necessary to determine gold assays to the $\frac{1}{10000}$th part of the normal assay weight, and it is hardly conceivable that a discrimination of the $\frac{1}{10000}$ part of the spark assay weight or the $\frac{1}{30000000}$ of a grain is practically possible. Even if it were, it would not be proper to assume that a test on such an atomic scale would correctly represent the value of a large deposit, or even of gold ingots. It would certainly, not be in the case of silver, which segregates."

A curious and unexplained anomaly was noticed relating to the sensitiveness of the spectroscope to metals present in small quantities in the form of alloys. It has been shown by Mr. Capel that $\frac{1}{1000}$ of a milligramme of gold will show a spectrum, if the spark be passed through a weak solution of the pure metal. But when operating on a slip of alloy formed of—

Silver	708
Copper	254
Gold	38
	1000

the spectra of copper and silver alone were visible. In an alloy of gold and copper containing from 200 to 250 parts in the thousand of the precious metal, the gold spectrum is barely visible. On the other hand, in an alloy of gold and copper containing 1 per cent of the latter, the copper spectrum was distinctly shown. In copper alloyed with 20 per cent of nickel the spectrum of the latter is not visible. Hence we arrive at the interesting fact that where two or more metals are present, "the spark will to some extent elect for its vehicle the one which is most rapidly volatilised."

Commenting on these facts Mr. Outerbridge remarks somewhat pointedly, that:—"If the spectroscope fails to reveal the presence of anything less than 200 parts of gold (20 per cent) in a base alloy, even a theorist must admit that one could scarcely expect to be able to discriminate with certainty a variation of $\frac{1}{1000}$ in a fine alloy." He therefore concludes, "not without regret, that assaying by means of spectrum analysis is impracticable for the purpose of Mint operations."

As an interesting fact, incidentally observed, it may be mentioned that "the loss in weight of the volatile metals very slightly exceeds, and in some cases does not equal, the loss of the less volatile metals."

Although the researches of Mr. Outerbridge have thus, for the present, failed as regards their more immediate object, they must not the less be pronounced a valuable contribution to spectroscopic analysis. We shall await with increased interest the results of the investigations with which Mr. Chandler Roberts and Mr. J. Norman Lockyer are still engaged.

CORRESPONDENCE.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—The confusion at the Chemical Society, in regard to the relations of glyoxylic acid, seems curious if not characteristic. When doctors disagree, it is hardly fair for an amateur to presume on a decision; nevertheless, for a large class of student readers a few hints may be offered.

Mr. W. H. Perkin, as usual, is a clear and safe guide, and few things are better established than the constitution of glyoxylic acid. Besides giving the amide $(C_4H_3O_6)H_2N$ and a good saltic list, Mr. Perkin said, "When that acid is heated with alcohol to 120°, it yields the compound "Diethyl-glyoxylate of ethyl." The radical becomes—

$$\left.\begin{matrix}C_4H_1O_6\\C_4H_5\\C_4H_5\end{matrix}\right\} = C_{12}H_{11}O_6,O + EO,$$

or E_2 replace H_2, according to the equation—

$$\text{Acid} + 2\ \text{alcohol} - 4HO = (C_{12}H_{11}O_6)O + HO.$$

M. Schreiber showed the same thing in 1870, and further obtained the amide $(C_{12}H_{11}O_6)H_2N$ in solid crystals fusing at 76·5°. Of all this Dr. Debus seems quite oblivious, and evidently confuses the matter with glyoxylic acid $C_2H_2O_3$, which in old notation would be $(C_4H_1O_4)O + HO$.

As acetic acid $-O_2$ = aldehyde;

So glyoxalic acid $-O_2$ = glyoxal or glyoxalic aldehyde.

M. Schiff's recent research on glyoxal is somewhat confused in a similar way, and his six-fold condensation is called "Hydro-hexa-glyoxal," of which he obtained aceto- and benzo-substitutional varieties. It is, however, manifest that in his oxy-condensing process the aldehyde is made to assimilate 2HO to the production of another acid, and it is almost beyond question that he might have said—

$$\text{Glycollic acid} + 5\ \text{acid} - 10HO = (C_{24}H_{13}O_{24})O + HO.$$

That this body would give an amide $(C_{24}H_{13}O_{24})H_2N$ is a foregone certainty.

The wonderful amount of labour, skill, and penetration evinced by Strecker, Baeyer, and others in ureide researches is much to be admired; but this same confusion is there woefully paramount.

Just as oxalic acid + urea − aq. = oxalyl urea,
So mesoxalic acid + urea − aq. = mesoxyl urea,

and these radicals, or H replacements, under very slight conditions, change, in one case giving glyoxalyl ureides $(C_4H_1O_4)$, and in the other tartronyl ureides $(C_6H_1O_6)$; but the names and types are exceedingly confused, and the difficulty is enhanced by the fact that some of the acids are mono-, and others (so-called) dibasic.

The following ureas are some of the simplest representations of these associated radicals:—

(1).	Oxalyl urea	$(CO_2)(C_2O_2)^2H_2N_2$
(2).	Glyoxalyl urea	$CO_2C_4H_1O_4H_3N_2$
(3).	" "	$CO_2C_4H_1O_2H_3N_2$
(4).	Mesoxyl urea	$CO_2(C_3O_3)^2H_2N_2$
(5).	Tartronyl urea	$CO_2(C_6H_1O_6)H_3N_2$
(6).	Malonyl urea	$CO_2C_6H_1O_4H_3N_2$
(7).	" "	$CO_2C_6H_1O_2H_3N_2$
(8).	Glycolyl urea	$CO_2C_4H_3O_4H_3N_2$
(9).	Glyoxyl urea	$CO_2C_4H_3O_6H_3N_2$

No. 3 is called glycolyl urea, or hydantoin $\left\{\begin{matrix}CO''\\C_2H_2O\\H_2\end{matrix}\right\} N_2$.

No. 8 is called allanturic acid $\left\{\begin{matrix}CO''\\C_2H_1O_2\\H_3\end{matrix}\right\} N_2$.

No. 5. Tartronyl urea, or dialuric acid, is notated—

$$\left.\begin{matrix}CO''\\C_2H_2O_3\\H_2\end{matrix}\right\} N_2.$$

It remains, therefore, that the acids of Nos. 3 and 7 should be identified and named; but the working character of the Chemical Society does not seem a very hopeful field for the attainment.—I am, &c.,

SAMUEL E. PHILLIPS.

PS.—It only just occurs to me that another element of confusion subsisted in this way. By a curious slip of the pen (I trust) Mr. Perkin calls his "Diethyl-glyoxylate" a glyoxalate; and with a perverse inversity Dr. Debus calls the ammonium salt of glyoxalic acid a glyoxylate! It also further happens that the glyoxylic amide and the ammonium glyoxalate are isomeric.

The amide $= (C_4H_3O_6)H_2N = C_4H_5O_6,N$
The A salt $= (C_4H_1O_4)O + AO = C_4H_5O_6,N.$

PRODUCTION OF ANILINE COLOURS WITHOUT THE USE OF ARSENIC ACID.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xxxi., page 56) appeared an article, "On the Production of Aniline Colours without the Use of Arsenic Acid," which mentions our firm, and says that although we succeeded in working this process on a large scale, we were manufacturing our colours only in part by this method.

In reply to this assertion, we beg to state that since the end of 1872 we have not been using any arsenic acid in our works at all, and that our magenta or fuchsine, as well as all the other colours manufactured by our firm, are warranted to be produced without the employment of arsenic acid, and to be entirely free from this poisonous reagent.—We are, &c.,

MEISTER, LUCIUS, AND BRÜNING.

Hœchst-on-Maine,
Feb. 11, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 3, January 18, 1875.

Saline Matters which the Sugar Beet-Root draws from the Soil and from Manures.—E. Peligot.—The author calls attention to a point generally overlooked in comparative agricultural experiments—the identity of the seed. In his opinion, the discrepancies and anomalies noted in such experiments are due less frequently to the mode of cultivation than to the strain of the seed. Since 1861 he has cultivated a small number of beets derived from about a score of seeds given him by M. L. Vilmorin, the result of experiments made with the aim of developing, by artificial selection, the proportion of sugar in the root. Their yield was from 14 to 17 per cent. The seeds sown in the open ground were re-planted in pots, care being taken to select roots of the same form and appearance. Pots holding about 30 litres were filled with ordinary garden earth of known composition. From July 1st to October 15th, 1871, six beets, which had been potted several weeks, received—Nos. 1 and 2, suitable waterings with Seine water, containing 1 grm. of sea-salt per litre; Nos. 3 and 4, with the same quantity of water, containing 1 grm. chloride of potassium; and Nos. 5 and 6 had the same volume of water without addition. Each of the former lots had received 30 grms. of salts. After some weeks, each couple presented a characteristic appearance which distinguished it from its neighbours. The presence of a saline matter, employed in a predominating quantity, gives the plant, therefore, a specific physiognomy. They yielded—

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	Weight of Root.	Ash. Per cent.	Chloride of Potassium. Per cent.
No. 1. (Sea-salt)	560·2	0·77	18·6
No. 3. (Chloride of potassium)	571·5	0·97	15·3
No. 5. (Water)	721·8	0·64	8·0

The sugar was about 15 per cent. This result is contrary to the common opinion that beet-roots rich in chlorides are poor in sugar. These two facts do not stand in connection. The chlorides accumulated in the leaves; for while the roots did not contain more than 3 to 6 per cent of mineral matter, the dried leaves having lost their 90 per cent of water, give 25 to 32 per cent. The saline matter of this ash contained from 23·7 to 73·5 per cent of chlorides. Even in beets watered with solutions of sodium chloride, the potassium is more abundant than the sodium. The experiments were resumed in 1872 under conditions very similar. The plants were watered from July 21st to October 9th with Seine water containing 1 grm. of chloride per litre in Nos. 3, 4, 5, 6, and 2·5 grms. per litre in Nos. 7, 8, and 9. The following was the composition of the roots:—

	Weight of Root, Grms.	Sp. Gr. of Juice at 15°.	Ash in 100 Parts of Juice.	Chloride Potassium in 100 Parts Ash.	Sugar in 100 Parts of Juice.
No. 1. (Water)	680	1080	0·83	7·1	15·3
No. 3. (25 grms. sea-salt) ..	635	1081	1·07	16·3	15·0
No. 5. (25 grms. potassium chloride)	650	1083	0·89	13·2	14·0
No. 7. (75 grms. sea-salt) ..	682	1087	1·07	27·3	16·4
No. 9. (75 grms. potassium chloride)	645	1090	1·20	26·8	15·8

It is seen that the absorption of chlorides increases with the quantity supplied to the plants; it has, nevertheless, its limits, and is not proportional to the quantity, since the two last roots contain scarcely double the quantity of chlorides of the former, whilst they have received triple the quantity of salts. Both chlorides and sulphates were found in very much larger proportion in the upper part of the root than in the lower. As their presence in the juice causes the formation of molasses, manufacturers ought to operate upon roots well freed from their necks. Water and saline matters were also found more abundant in the central parts of the root than in the exterior, whilst the latter were more charged with salts of lime and magnesia. In 1873 beets were cultivated in a very poor siliceous earth, sparingly penetrable by water, and cracking in time of drought. From July 3rd to September 3rd the roots received—

No. 1 and 2.—24 grms. of sea-salt, at 2 grms. per litre of Seine water.
Nos. 3 and 4.—The same weight of potassium chloride.
No. 5.—36 grms. nitrate of potash, 4 grms. per litre of water.
No. 6.—The same weight of soda nitrate.
No. 7.—25 grms. ammonia sulphate.
No. 8.—35 grms. sal-ammoniac.
No. 9.—Seine water without addition.
No. 10.—42 grms. acid phosphate of lime (6 grms. per litre of water).
No. 11.—24 grms. of Jeannel's mixture, *i.e.*, phosphate of lime, sulphates of ammonia and magnesia, nitrate and chloride of potassium.

In August the aspect of the plants was different: the leaves of Nos. 1 and 2 were ill-developed, and began to turn yellow. In Nos. 3 and 4 the leaves were very small and yellow. It seems that the alkaline chlorides, unless accompanied by fertilising matters, do not exert a useful effect on vegetation. In the plants watered with the nitrates, the ammoniacal salts, and phosphate of lime, the leaves were of a deep green, large, and plentiful. The beet watered merely with Seine water was little developed; the leaves were small and yellow. On October 14, No. 10 showed the most luxuriance; and next, those which had received ammoniacal salts and Jeannel's mixture; then the nitrates. On October 28th, a part of the roots and leaves were weighed. No. 10 was the finest; its root weighed 932 grms. If we represent this weight by 100, we have the following proportions for the weight of the other roots:—Nos. 5, 6, 7, 8, from 34·3 to 36·7; Nos. 1, 3, 9, from 6·3 to 13·4. The ashes of these beets do not present very striking differences of composition. No. 7 contained 9 per cent of alkaline sulphates, or about double the normal quantity. No. 10 gave an ash of the following composition:—

	Roots.	Leaves.
Silica	0·5	1·7
Carbonate of lime	5·3	27·7
Phosphate of iron	1·6	1·5
Phosphate of magnesia (bibasic) ..	8·0	8·5
Phosphate of potash (tribasic) ..	29·8	5·7
Sulphate of potash	5·4	6·4
Chloride of potassium	4·8	6·5
Carbonates of potash and soda ..	44·6	41·8
	100·0	100·0

Thus the use of soluble phosphate of lime diminishes the proportion of calcareous salts absorbed by the plant. The amount of phosphoric acid is approximately alike in all beet-roots, and is not increased by watering with phosphate of lime in solution. This result throws a new light upon the part played by phosphates in vegetable production. Many salts are absorbed by plants unchanged, such as the alkaline nitrates, the use of which in manures causes great annoyance to the sugar manufacturers.

Temperatures Below Soils Covered with Turf, or Denuded.—M. Becquerel and E. Becquerel.—The temperature below the denuded surface, in frosty weather, is much the lower.

Ammonia of the Atmosphere.—M. A. Schlœsing.—The author shows that in the transformations of organised beings a certain quantity of nitrogen leaves the combined state and is set free, so that the total sum of azotised compounds existing in the world would suffer continual diminution if there were no restoratory process. Such a process has been placed alternately in the atmosphere, in plants, and in soils. The action of the last being doubtful, and that of the second no longer admitted, atmospheric electricity seems to be the sole restorative process which is definitely established. The author proposes to examine whether the quantity of combined nitrogen brought down by rain is really sufficient to maintain the equilibrium. The sea serves as an immense reservoir of combined ammonia.

Functions of Fungi.—M. Müntz.—It is well known that fungi, placed in an atmosphere containing oxygen, absorb this gas, and give out carbonic acid in equal volume. Marcet shows that when the oxygen is consumed they develop carbonic acid at the expense of their own substance, but their production of hydrogen is not unanimously accepted. The author's experiments prove that if oxygen is excluded the production of hydrogen is considerable.

Decomposition of Fehling's Liquid; Determination of Glucose in Presence of Sugar.—P. Champion and H. Pellet.—To determine glucose in presence of excess of sugar, the authors add an excess of Possoz's liquid (a modification of Fehling's, in which carbonate of soda is used instead of caustic), and keep it at 75° in the water-bath for three-quarters of an hour. Collect on a filter the suboxide formed and wash it; then place the filter, still damp, in a capsule, and add dilute hydrochloric acid, which converts the suboxide of copper into subchloride. The liquid is collected and raised to a boil, adding by degrees some crystals of chlorate of potash. The liquid becomes coloured, and the copper passes into the state of bichloride of copper of a greenish yellow, when it is titrated with chloride of tin. The ebullition is maintained till all the chlorine products have been expelled. This is ascertained

by fixing to the mouth of the flask containing the solution a tube bent twice, and plunged into water coloured blue with sulphate of indigo. In this manner a few milligrms. of glucose may be determined in 100 grms. of sugar.

Bulletin de la Societe Chimique de Paris, No. 12, December 20, 1874.

Thermic Study of the Phenomena of Solution; Reaction of Water with Nitric Acid.—M. Berthelot.—Not suited for abstraction.

Definite Hydrates Formed by Acids and Alkalies in Solution.—M. Berthelot.—The author submits proofs of the existence of such hydrates in solution, in opposition to the views of Prof. Thomsen.

Synthesis of Purpurin.—M. Felix de Lalande.—M. Rosenstiehl has repeated and confirmed the author's experiments described in *Comptes Rendus*, lxxix., p. 766. He adds a few words on his preliminary researches:—Having caused nitrate of methylen to act upon alizarin in sealed tubes at 100° C. for several hours, he obtained, after evaporation of the liquid, a body having the aspect of alizarin, and dyeing with aluminous mordants an orange-yellow; not very bright. In contact with water, and more rapidly with alkalies, this substance is transformed into a new colouring matter, the properties of which have a certain analogy with purpurin, being, like it, soluble with a gooseberry-red in alkalies, and dyeing a red with alum mordants. Strecker, in 1869, obtained an analogous body by the action of fuming nitric acid upon alizarin. When boiled in water it gave rise to a compound analogous to purpurin, which Strecker named nitroxyalizarin, or nitro-purpurin. The author has prepared this body according to Strecker's process, and finds it identical with the substance obtained by the action of the nitrate of methyl. Purpurin treated with nitric acid gave a body having the same properties as nitroxyalizarin, whence the author concludes that the latter is the nitro compound of purpurin. Hence he inferred that in the action of nitric acid upon alizarin it may be divided into two phases—the transformation of alizarin into purpurin; and, secondly, the nitro-substitution of the latter.

Distribution of Bands in Primary Spectra.—G. Salet.—Already noticed in the Chemical News.

Action of "Glover's Tower" in the Manufacture of Sulphuric Acid.—M. Vorster.—Glover's tower is placed between the furnaces evolving sulphurous acid and the lead chambers. The hot gases proceeding from the kilns pass through a rain of chamber acid and of nitrated acid. The heat concentrates the acids by evaporating water, and the nitric acid present in the nitrated acid is converted partly into nitric oxide, and partly into free nitrogen. At the foot of the tower the acid, concentrated and freed from nitrogen acids, is collected. In such a tower, 9 metres high by 3, 1400 kilos. of water are evaporated in twenty-four hours, whilst 550 to 600 kilos. of sulphuric acid are formed. From 3·5 to 4 per cent of the acid passing through the tower is evaporated. Although the acid is freed from nitrogen compounds to a satisfactory extent by the action of the sulphurous acid, yet from 40 to 70 per cent of these compounds—according to temperature—are reduced to the state of nitrogen gas.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of metallic compositions having phosphorus combined therewith, the same being applicable for bearings and other parts of machinery exposed to friction. Edward Primerose Howard Vaughan, F.C.S., patent agent, Chancery Lane, Middlesex. (A communication from Charles Künzel, Ph.D., Blasewitz, Saxony.) May 8, 1874.—No. 1628. This invention consists in the manufacture of metallic compositions having phosphorus combined therewith, such metals being employed as possess different degrees of fusibility, so that the mixture, after being heated, forms in the process of cooling a porous or cellular mass, the pores, or cells, or interstices of which are filled with the more fusible and softer metal (which has become more or less mixed or alloyed with one or more of the harder and less fusible metals) surrounded by the harder or less fusible metal, the latter forming the walls of the cells. The softer or more fusible portion of the mass constitutes the rubbing face which is exposed to friction. The following are the approximate proportions of the compositions:—(*a*) One half per cent to 3 per cent of phosphorus, 4 per cent to 15 per cent of lead, 4 per cent to 15 per cent of tin; the necessary proportions of copper being in each case added to make up 100 parts. When more than ordinary hardness is desirable in the formation of the cells, the following approximate proportions are used. (*b*) One quarter per cent to 2 per cent of phosphorus, 4 per cent to 15 per cent of lead, 4 per cent to 15 per cent of tin, 8 per cent to 15 per cent of zinc. The necessary proportions of copper being added in each case so as to make up the 100 parts.

Improvements in the mode of and apparatus for treating phosphates of lime. Edward Primerose Howard Vaughan, F.C.S., patent agent, Chancery Lane, Middlesex. (A communication from Count Hayttens de Terbecq, Paris.) May 9, 1874.—No. 1644. The object of this invention is improvements in means and apparatus for facilitating the extraction of the soluble constituents of phosphates of lime for agricultural purposes. The apparatus is composed of a skeleton drum containing the phosphates, and revolving in a trough charged with a mixture of hydrochloric or nitric acid and water, and the product of the operation may either be applied direct after neutralisation as liquid manure, or reduced to a solid state by after-evaporation and treatment by sulphuric acid alone or combined with fertilising salts.

An improvement in proces of and apparatus for desilvering and refining lead. Gustave Luce, of the firm of Luce, Son, and Rozan, manufacturers, Marseille, France. May 11, 1874.—No. 1662. This invention relates to improvements in the process and apparatus for refining and desilvering lead, described in C. D. Abel's Specification, No. 3292, of 1869. According to the present invention, air or other compressible gas is employed in place of steam for oxidising the impurities of the lead and producing its ebullition and consequent crystallisation, the air or gas being forced in through a pipe passing horizontally into the cauldron containing the lead near the bottom thereof. The pipe is provided with a cock or valve for regulating or cutting off the supply of air or gas.

Improvements in the production of caustic alkalies and of carbonic acid. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Charles Juron, Antoine Imbert, Joannes Juron, and Louis Imbert, all of Paris.) May 11, 1874.—No. 1672. This invention relates to the conversion, on a commercial scale, of alkaline carbonates into caustic alkalies by a dry method, and to the production of carbonic acid; and consists in introducing steam at a suitable pressure into a furnace or tube, in which it is superheated, and then causing such superheated steam to pass through or to come in contact with the mass of carbonate to be converted, such carbonate being placed in its ordinary condition in a receptacle composed of copper or aluminous clay.

Improvements in the manufacture of an artificial fuel from sewage deposits, night-soil, and other dry and moist manurial matters mixed with other materials. Gustav Alsing, Preston, Lancaster. May 12, 1874.—No. 1689. The novelty of my invention consists in utilising sewage deposits, night-soil, and other dry and moist manurial matters, by mixing it with other carbonaceous, deodorising, bituminous, and other suitable material for the purpose of making it into a useful and cheap artificial fuel.

A new system of bleaching, and in the apparatus employed therein. Harold Potter, bleacher, Manchester, Lancaster. May 12, 1874.—No. 1690. My invention consists in placing the yarn or fabric on perforated partitions in a closed vessel capable of resisting a pressure of about 200 lbs. to square inch, and in causing a circulation of hot water through the same at a pressure of about 200 lbs. per square inch, which is kept up until the operation is completed.

MEETINGS FOR THE WEEK.

Monday, Feb. 22nd.—Medical, 8.
—— London Institution, 5.
—— Geographical, 8.30.
—— Society of Arts, 8. (Cantor Lectures.) Rev. Arthur Rigg, M.A., "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft."

Tuesday, 23rd.—Civil Engineers, 8.
—— Anthropological, 8.
—— Society of Arts, 8. Mr. Thomas J. Hutchinson, F.R.G.S., F.S.A., "On the Social and Domestic Slavery of Western Africa in its bearing upon Commercial Progress."
—— Royal Institution, 3. Alfred H. Garrod, Esq., "On Animal Locomotion."

Wednesday, 24th.—Geological, 8.
—— Society of Arts, 8. Captain Bedford Pim, "On the Mercantile Marine of Great Britain.

Thursday, 25th.—Royal, 8.30.
—— Royal Institution, 3. Professor Tyndall, "On Subjects Connected with Electricity."

Friday, 26th.—Royal Institution, 8. Weekly Evening Meeting. Mr. W. R. S. Ralston, "Popular Tales: their Origin and Meaning," 9.
—— Quekett Club, 8.

Saturday, 27th.—Royal Institution, 3. Prof. W. K. Clifford, "On the General Features of the History of Science.'

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THE CHEMICAL NEWS

Vol. XXXI. No. 796.

ON THE MANUFACTURE OF CAUSTIC SODA.*

By JOHN MORRISON, F.C.S.

I do not wish to make needless apologies, but, since undertaking to prepare this paper, other duties have pressed so heavily upon me, that I have been obliged to content myself with a much less complete treatment of the subject than was my original desire and intention. As the paper stands, it is but little beyond a revised transcript of a series of rough notes I prepared for a special object some six months ago, when occupied in one of the Lancashire caustic soda works; though as such it will, I believe, be found a thoroughly practical description of the process and plant in general use—certainly nothing more, and I venture to hope, nothing less. That it is not something beyond is, may I say, my misfortune, not my choice; a misfortune which I certainly regret, and my regret is that, possessing the will, I lacked the opportunity of carrying it fully into effect.

I have frequently lamented the apparent absence of identity about the status of a chemical works manager. It seems quite a question whether our calling ought to rank as a profession, or whether we do not rather belong, plainly and simply, to a superior order of works detective. We are a class of men called into existence, as most other classes of men, by Mother Necessity, but occupying a somewhat abnormal position (I do not speak of the Tyne especially); and, probably from the peculiarity and the variable character of our employment, there has not yet been devised any special course of training for aspirants to our office.

Most of us are of laboratory descent—men who, with a strong love to the calling of our choice, have early yielded to the discovery that we could never look to analytical chemistry otherwise than as a sort of *pis-aller*—a kind of out-at-elbows trade—forming simply a stepping-stone to an indefinite something better. That at first undefined something, however, speedily resolved itself into a managership; and a managership, therefore, became henceforth the summit of our most ardent hopes. Educated, then, in such a way, it is not surprising that some of us experience an occasional hankering after laboratory work, though, unfortunately, our longings are rarely unaccompanied by vague misgivings that we are pandering to a kind of mortal sin that must be eschewed, or that the work is a sort of happy pastime which to us, for our offences, is for ever proscribed. In fact, many of us have gradually taught ourselves to look upon the laboratory almost in the light of a necessary nuisance, an institution only of use to ascertain if we get full value in our raw materials, and that our finished products are sent out up to strength. Henceforward, we have said to ourselves, our chemistry must be confined to productions and costs per ton, and, in Lancashire especially, to quantity turned out per furnace; the best manager being he who, *prima facie*, can get the greatest number of tons out of a given number of men and a given amount of plant.

But our early laboratory training, if sufficient to carry us in safety over many quicksands, was, perhaps, one of the very worst to fit us for the miscellaneous duties of our new sphere of labour; for while, as it seems to me, the chemist is perpetually living in the visionary future, the manager must ever be occupied with the business of to-day. In many things he has to act more by a sort of instinct or intuition, than by the more philosophical methods of reasoning peculiar to the chemist; building up, by a close observance of men and things, a kind of stock-in-trade of ideas, commonly called practical experience, and from the latter, to him, infallible source, often arbitrarily enough deducing his own peculiar theories. His leading maxim is, an ounce of wit equals considerably over a pound of ability; so as often as not, he cultivates his wits as a most tender plant, and leaves ability to come up as a weed taking care of itself. And after all, as some one has observed, it is not the men of ability who are the most successful, but those who can concentrate the most faculties—which, I take it, are pretty much the same as wits—upon a given subject.

This practical experience (either our own or some one else's) is, I imagine, as a general rule, the safest basis on which to act; for speculative theorising is dangerous ground, and, to nine men out of every ten who indulge in it, a species of gambling, which may, indeed, cast up in their favour, but will more probably go against them. It is much safer, in short, to act the sheep, and copy the good points of our neighbours, than to assume the shepherd, and be continually plunging into untried paths; for in the one case if we go wrong, we can generally saddle the blame on others, while in the other we must bear, in a world where the only test of merit is success, the brunt of failure ourselves.

There is nothing, I am persuaded, stands a manager in such good stead as simple, practical, discriminating common sense, united to the faculty of discerning intuitively the relation between a given cause and its probable effect. Any man can detect a leakage in a pipe, or a vat, or a settler; but not every man can at a glance trace its result, and distinguish between a trivial defect, the repair of which may serve the fitter as a stock-job, and an important one which, if neglected, may lose many pounds.

It is, I believe, possible, strange as to some it may appear, for a manager to be too much of the chemist, and to sigh too earnestly after maximum productions. Splendid productions—that is, very high percentages—from salt-cake, or sulphur ore, or anything else, may be dearly purchased. Twenty middling black-ash balls per shift per furnace, for instance, would, I am inclined to think, really pay better than fourteen or fifteen first rate ones, containing a minimum amount of sulphate on alkali, in spite of worse produce shown in the process book, for it must never be overlooked that it is really quantity turned out, and not so much "production" that makes a works pay. Indeed, if a manager keep up his tonnage per week or month to the maximum standard, the process book may, as a general rule, be left pretty much to look after itself.

To no department of the alkali manufacture is this doctrine more applicable than to that of caustic soda. Essentially a branch which, to pay well, must be worked at the very highest possible pressure, it is one to which the slow and sure theory must not for a moment be applied, and a manufacture likewise in which, without any excess of chemistry, there must be the most searching, constant, and energetic supervision; and with such supervision the whole process lies in a nutshell.

To achieve the best results, two things are necessary—first, that the plant be well proportioned and in sound condition, and secondly (as I have just hinted) that it be worked to the very best advantage. The latter especially, for in an alkali works whether small or large, there are certain what may be termed fixed expenses, such as foremen, mechanics, and clerks, and these charges with a small turn out, become as we all know very serious. It is a capital thing to bring as frequently as possible all expenses to terms of per ton of alkali produced, for we are never, as it seems to me, so well able to plan out reductions on working costs, &c., or to study the effects of modifications or fancied improvements, as when face to face with our actual position stated in terms which we can comprehend at a glance. But my preface has reached a greater length than I intended.

* A Paper read before the Newcastle-upon-Tyne, Chemical Society.

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The literature of caustic soda seems singularly scant, for, excepting through the medium of stray notes in scientific journals, there does not exist, so far as I am aware, any detailed description of the manufacture of white caustic soda as carried on at the present time. There were, I believe, no samples of this article in the Exhibition of 1851, so that the industry is one of comparatively recent date, and rather strangely, the process is confined almost entirely to the Lancashire districts. Why it does not work equally well on the Tyne, I can I think, after an inspection of some of the appliances in use, imagine; though that the sole cause is the inferiority of "Tyne" chalk to "Lancashire" limestone I am slow to believe; and that its manufacture could be made with suitable plant to yield a fair margin of profit, I feel pretty confident. It is a current belief however here, that caustic soda is chiefly produced from "red" liquors, but that nothing can be further from the truth, I think the details I am about to give will amply prove. Good white caustic soda from "red" liquors alone is, I fear, almost an impossibility in the present state of manufacturing experience.

It will be scarcely necessary to describe the properties of caustic soda. Its digestive powers are well known to be of the very highest order, and its especial fondness for delicate portions of the cuticle, the fingers and faces of those of us who have had much to do with it, have often painfully attested. Linen or cotten clothes resist its action much better than woollen ones, a fact which is taken advantage of by most of the workmen who have to deal with it. It is very cleanly in its habits. It abhors dirt quite as intensely as nature abhors a vacuum, and like a certain well-known quadruped—loveliest perhaps in death—it is not so particularly disagreeable when kept strictly clean, but if carelessly neglected, it has a tendency to become an insufferable nuisance. Of all messes, a caustic one is perhaps the worst. A manager under its influence is sincerely to be pitied, and should he, in accordance with his natural temperament, become either persistently morose or energetically frantic, it is better to move quietly out of his way, for while he is worthy of your utmost sympathy, you can rarely be of much service. Cleanse therefore all pans from scale and limy sediment every few weeks. Never mind the trouble; for if this you neglect, an evil day, though long deferred, will surely and perhaps suddenly come.

I think for the sake of clearness, I should like to complete the task before me under three distinct headings. The first to include a general description of the plant in common use in Lancashire; the second to embrace the practical details of the manufacture; and the third to consist of analysis, costs, and miscellaneous observations.

(To be continued.)

ANALYSIS OF THE AIRTHREY SPRINGS AT BRIDGE OF ALLAN.

By WILLIAM JOHNSTONE.

The mineral springs of Airthrey have been known to exist from a remote period. The workings of a copper mine on the Airthrey estate led to their discovery.

There are four springs in the mine about 300 yards from the bottom of the shaft. Three of the springs are collected in a cistern immediately under the shaft, and by means of a lead pipe and force-pump the water is raised 30 fathoms, and then conveyed to the well-house. The flow of water is about 1000 gallons in the 24 hours.

The following is the result of the analysis of a sample of the water taken from the storing tank at 1 p.m. on the 7th March, 1874, immediately after the engine had stopped pumping.

Temperature of the water	48° F.
Temperature of the atmosphere	62° F.
Specific gravity of the water at 60° F. ..	1·00865

Sulphuric anhydride	0·02373	Sodium ..	0·01364
,, ,,	0·24581	Calcium ..	0·12290
,, ,,	0·00332	Strontium ..	0·00363
Chlorine	2·69376	Sodium ..	1·74636
,, ...	2·10302	Calcium ..	1·28389
,, ...	0·00460	Magnesium	0·00155
,, ...	0·02615	Potassium	0·03002
Bromine	0·00296	Magnesium	0·00050
Carbonic dioxide ..	0·00685	Magnesia ..	0·01274
,, ,, ..	0·00104	Ferrous oxide	0·00142
,, ,, ..	0·06985	Lime	0·08890
Phosphoric anhydride	0·00026	,, ...	0·00023
Total acids, &c. ..	5·18135	Total bases, &c.	3·30578

The water also contains traces of manganese, copper, lithium, barium, and iodine.

The water contains the following gases expelled by boiling—

1 litre contains	21·890 c.c.
Oxygen	4·326
Nitrogen	10·832
Carbonic dioxide	6·732
	21·890

The above results expressed in grammes per litre:—

Sodium chloride	4·44184
,, sulphate	0·04213
Calcium chloride	3·28782
,, sulphate	0·41788
,, carbonate	0·15876
,, phosphate	0·00034
Strontium sulphate	0·00763
Magnesic chloride	0·06160
,, bromide	0·00386
,, carbonate	0·02678
Potassium chloride	0·05498
Ferrous carbonate	0·00276
Silica	0·00203
	8·50841
Total residue dried at 356° F. ..	8·48713
Volatile and organic matter	0·01326
Total solid residue in 1 litre	8·50039

9, Royal Terrace, Edinburgh.

ON THE

VALUE OF THE SO-CALLED CHAMELEON BAROMETER, AS AN HYGROMETER.

By A. PERCY SMITH, F.C.S.

A piece of bibulous paper soaked in cobaltous chloride, is blue when dry and red when moist, and I have found it very sensitive to slight changes in the quantity of moisture in the atmosphere.

A paper, prepared as above, was suspended in a room on the wall, facing a south window, which was kept open during the day. By its side were two thermometers, wet and dry bulb, reading to 2° F.

Observations were made three or four times a day for nearly a year.

The colour of the paper was estimated at from 0 (red) to 10 (blue).

I adjoin some of the readings taken. More are unnecessary from their similarity.

It would appear that the *actual* temperature has no appreciable effect on the colour of the paper, as it registers the same, for the same difference between the two thermometers, whether in winter or in summer.

I have found as a general rule that the paper is more sensitive than the thermometers I used, and I think that

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such a paper is very convenient, as it enables one to see at a glance whether the air is moist or dry, and even, approximately, to estimate the amount of moisture.

Date.	Dry Bulb.	Wet Bulb.	Difference.	Colour of Paper 0—10.	Remarks.
1874.					
July 8th.					
1.30 p.m.	72·0	60·0	12·0	9·0	Very hot day.
5.30 „	74·0	61·0	13·0	10·0	Paper quite blue.
12.30 „	70·0	59·0	11·0	8·5	
July 10th.					
9.30 a.m.	74·5	65·0	9·5	8·0	Much hotter than 7th or
1.30 p.m.	77·0	67·0	10·0	7·0	8th, yet paper not so
5.30 „	79·0	67·0	12·0	9·0	blue.
Sep. 29th.					
1.30 p.m.	62·0	57·0	5·0	2·0	
Sep. 30th.					
1.30 p.m.	62·0	56·0	6·0	3·0	
8 „	64·0	61·0	3·0	1·0	Barom. falling for rain.
Oct. 1st.					
9.30 a.m.	62·0	58·0	4·0	—	Had rained in night.
10.30 p.m.	63·0	59·0	4·0	1·0	Barom. risen slightly.
Oct. 2nd.					
1.30 p.m.	59·0	55·0	4·0	—	Barom. falling, showery.
6.40 „	58·0	53·0	5·0	1·0	Barom. steady, cleared up.
Oct. 4th.					
1 p.m.	57·0	52·0	5·0	1·0	Fine.
Oct. 5th.					
9 a.m.	55·0	50·0	5·0	2·0	Barom. rising.
Oct. 6th.					
1.30 p.m.	53·0	50·0	3·0	—	Barom. falling, wet night.
Oct. 20th.					
9 a.m.	55·0	50·0	5·0	1·0	Fine morning.
8 p.m.	60·0	59·0	1·0	—	Barom. fell ½-inch, very stormy night.
Oct. 23rd.					
1.30 p.m.	52·0	48·0	4·0	1·0	Wind N.
6.30 „	55·0	54·0	1·0	—	Wind W.
Dec. 3rd.					
10 p.m.	43·0	40·0	3·0	2·0	Sharp frost.

Rugby, Feb. 12, 1875.

ON THE DEGRADATION OF THE COLOUR OF VERMILLION, OCCASIONED BY CONTACT WITH COPPER AND BRASS.

By K. HEUMANN.

SOME years ago Karmarsch (*Ding. Polyt. Journal*, cxxxvi., p. 153), investigated the circumstance that if copper plates are employed in printing vermillion, the impressions are generally brown or blackish. In the manufacture of playing-cards it has also been observed that if brass is used in grinding up the colour, its beauty is seriously impaired, the red becoming at first brownish, and very soon deep-brown and utterly useless. Karmarsch perceived at once that this change of colour depended in the formation of copper-sulphide, but supposed that the requisite sulphur was derived from impurities in the vermillion, as a decomposition of the latter under such circumstances, at ordinary temperatures, is highly improbable, and as chemical manuals furnish nothing analogous.

The author having recently shown* that this decomposition of vermillion, though at that time regarded as highly improbable, actually occurs regards Karmarsch's proposal, to boil the vermillion before use in a solution of pure potash, as useless, and has therefore repeated the experiments of the latter chemist.

The author had at his disposal a very pure vermillion, perfectly free from metallic mercury, which, when boiled with solution of potash, left it quite colourless, and yielded to it no demonstrable traces of sulphur. Nevertheless a bright plate of copper or brass was immediately coated with black copper-sulphide, if the vermillion—previously extracted three times with fresh potash-lye and then washed—was rubbed upon it with a cork. Perfectly dry vermillion requires a somewhat strong pressure to produce this effect. If it is previously rubbed up to a paste with water, pressure with the finger is sufficient to blacken the copper. On stronger friction with a cork, a part of the black coating becomes separated from the metal, mixes with the rest of the vermillion, and gives it a blackish colour; whilst the copper where it has been in contact with the vermillion is strongly amalgamated. It is even possible to write upon copper or brass with a piece of sublimed vermillion, the characters appearing silvery white after the metal has been rinsed in hydrochloric acid. The ready decomposability of vermillion, as shown by this experiment, cannot be removed by boiling in potash. Karmarsch, however, declares that commercial vermillion may be freed by two methods from those sulphur compounds which, in his opinion, cause the formation of copper sulphide:—first, by boiling with potash lye; and secondly, by stirring up the vermillion to a paste with water, and introducing pieces of metallic copper, which were to seize upon the sulphur, and thus deprive the vermillion of the power of blackening any further quantity of copper.

This result can only be explained by assuming that in his experiments qualities of vermillion were used which really contain soluble sulphur, by which the copper was affected, whilst the vermillion was not in such close contact therewith as to undergo decomposition. Following Karmarsch, the author laid a bright copper coin for some time in a paste of vermillion and water, and found, on rinsing it, that the metal was really almost unchanged. Those places only which had been accidentally touched with a glass rod, in stirring up the mixture, were blackened. Wherever the copper had come in collision with the side of the vessel within the paste, thus occasioning close contact between the metal and the vermillion, blackening and amalgamation of the metal were manifest. The results of Karmarsch's experiments are possible only if the pieces of copper remained motionless in the colour paste, and thus were able to take up merely free or dissolved sulphur.

As in printing, &c., with vermillion, the contact necessary for the decomposition of the metal occurs; the degradation of the colour cannot be prevented by previous boiling with potash. Vermillion rubbed up with oil is much less readily attacked than if dry or mixed with water. Iron decomposes vermillion only at elevated temperatures, and can therefore be used for rubbing and grinding without injury to the colour. Zinc has a very slight decomposing action if rubbed with vermillion, and the zinc sulphide, if formed, is white—the change of the red colour is scarcely perceptible.

Karmarsch states, in a note to his Memoir, that extraction with potash lye is not to be recommended for all sorts of vermillion. One sample was rendered decidedly brown by this process. A sample of vermillion prepared in the moist way was sought to be freed from an admixture of metallic mercury by boiling with dilute nitric acid, in consequence of which it assumed a lighter colour, and, on subsequent treatment with caustic or carbonated alkalies or ammonia, it became a deep black. In consequence of the action of mercuric nitrate upon a portion of the vermillion there was formed the white compound—

$$(2HgS + Hg(NO_3)_2),$$

which made the red colour rather paler, and, on decomposition with alkalies, yielded a black mixture of mercuric oxide and mercuric sulphide.—*Ber. der Deutsch.*

* *Annal. Chem. Pharm.*, bd. clxxiii., p. 21. *Berichte*, vii., p. 753.

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SOCIETY OF PUBLIC ANALYSTS.

"SALE OF FOOD AND DRUGS ACT, 1875."

This Bill being, of course, at the present moment a matter of considerable interest to our readers, we reprint its full text, and also as much of the discussion on the second reading as our space will admit of, and we only regret that we have not sufficient room for a verbatim report of the various speeches, which, had it been possible, we should have had much pleasure in publishing. However, we must content ourselves with referring our readers to so much of the debate as is to be found in our columns, and particularly to the speech of Dr. Lyon Playfair, which displays perhaps a greater knowledge of the subject, and a juster appreciation of the position of the Public Analysts, than that of any other speaker.

It will be at once obvious to all Analysts that the Bill, as it stands, contains some clauses which—if allowed to remain unaltered—would render it retrogressive, if not absolutely nugatory.

To the modification or removal of these objectionable clauses the Council of this Society has devoted itself, and though it is impossible to say *exactly* what alteration the Government will make, until the Bill appears in Committee on the 4th proximo, we have the satisfaction of knowing from Mr. Sclater-Booth that all our suggestions will be carefully considered, and many of them certainly accepted.

Amongst the points we have specially urged on the Government we may mention the following:—

That in the 3rd Section the words "Every article of food or drink" should be substituted for the words "Every article eaten or drunk," the latter phraseology, though its meaning may be perfectly plain, yet being open to the plausible argument that certain substances—such, for instance, as tea, coffee, &c.—are, in their natural state, neither "eaten" nor "drunk."

That in Section 6 the word "knowingly" should be omitted from the first line, as its retention—as the experience of our readers will confirm—would render a conviction impossible, the proof of guilty knowledge on the part of the vendor being out of the question. We also objected to the words "according to the usage of trade," in the third exception under this same Section, and we contend that the admission of such a phrase would be a direct incentive to adulterate, for it is clear it would be only necessary to prove that some given adulteration was *extensively* practised to render it legally allowable.

In subsequent Sections we also demurred to the words "the usage of trade," as in every case opening the door to further adulteration.

In Section 9 we urge the excision of the word "knowingly," for the same reason as in Section 6.

Section 12 we propose to make read somewhat thus:—"Any purchaser of any article of food, in any district, county, city, or borough, where there is any Analyst appointed, shall be entitled, on payment to the Analyst—or if there be no such Analyst then acting for the district, then to the Analyst of a neighbouring district—of such sum as shall be agreed upon between such person and the Analyst, to have such article analysed," &c.

The importance of the omission of the words "ten shillings and sixpence" will be at once apparent, and we have reason to think that on this point the Government will give way.

In Section 13 we contend that when an Inspector, employed for the express purpose of purchasing samples for analysis, has purchased such samples, he shall, as a part of his duty, at once take the same to the Analyst. To allow him any discretion on this point appears to us absurd, and we do not understand how such a clause has crept into the Bill.

In Section 14, as a natural sequence, we also propose the omission of the words "if he deem it right to have the article analysed."

In Section 21 we suggest the insertion of a provision that the Analyst *shall* be paid a fee for every attendance in Court, and this we believe will be agreed to.

To Section 22, as it stands, we have the strongest objection; but the substitution of the word "another" for "adjoining," in the fourth line, and the elimination of the words "who shall thereupon make the analysis as if he were applied to by any officer in his district," we think will at any rate render the clause innocuous.

In Section 25 we have pointed out the absence of any provision for prosecuting the wholesale dealer who may have given a warranty of the purity of an article which is found to be adulterated, but for which the retailer cannot be punished, in consequence of his possession of such false warranty.

There are various other points to which we have directed the attention of the Local Government Board, but to which we have not here space to allude. We hope, however, to return to the subject next week; and though the Bill, as drafted, was certainly a most unpromising one, we yet hope that in Committee it may be purged from its most glaring blots, and be made a useful and practical measure. We may, at any rate, add that no efforts on our part for the arrival of this "consummation most devoutly to be wished" will be wanting,

The following is the text of the above named Bill, which was read a second time in the House of Commons on Friday, the 19th instant; it bears the names of Mr. Sclater-Booth and Mr. Clare Sewell Read, the President and Secretary of the Local Government Board, and the House will go into Committee on it on Thursday, March 4th:—

Whereas it is desirable that the Acts now in force relating to the adulteration of food should be repealed, and that the law regarding the sale of food and drugs in a pure and genuine condition should be amended:

Be it therefore enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

1. From *the commencement of this Act* the 23 & 24 Vict., c. 84, 31 & 32 Vict., c. 121, s. 24, and the 35 & 36 Vict., c. 74, shall be repealed, except in regard to any appointment made under them and not then determined, and in regard to any offence committed against them or any prosecution or other act commenced and not concluded or completed, and any payment of money then due in respect of any provision thereof.

2. This Act shall not apply to Scotland or Ireland except as herein provided.

3. The term "food" shall include every article eaten or drunk by man, other than drugs:

The term "drug" shall include medicine for internal or external use:

The term "county" shall include every county, riding, and division, as well as every county of a city or town, not being a borough:

The term "justices" shall include any police and stipendiary magistrate invested with the powers of a justice of the peace.

Description of Offences.

4. No person shall knowingly mix, colour, stain, or powder, or order any other person to mix, colour, stain, or powder, any article of food with any ingredient or material of a nature injurious to health, with intent that the same may be sold in that state, and no person shall knowingly sell any such article so mixed, coloured, stained, or powdered, under a penalty in each case of *fifty* pounds for the first offence; every subsequent offence, after a conviction in such penalty, shall be a misdemeanour, for which the person, on conviction, shall be imprisoned for a period not exceeding six months with hard labour.

5. No person shall knowingly, except for the purpose of

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compounding as hereinafter described, mix, colour, stain, or powder, or order any other person to mix, colour, stain, or powder, any drug with any other ingredient or material of a nature injurious to health, with intent that the same may be sold in that state; and no person shall knowingly sell any such drug, so mixed, coloured, stained, or powdered, under the same penalty as in the last clause for a first and subsequent offence.

6. No person shall knowingly sell any article of food or any drug which is not of the nature, substance, and quality of the article demanded by the purchaser, under a penalty of *twenty* pounds, except as herein excepted and provided; that is to say, except—

Where any matter is mixed therewith for the purpose of rendering it portable, or of preserving it;

Where a harmless ingredient is mixed with it for the purpose of rendering it palatable or of improving its appearance;

Where according to the usage of trade it is sold in a mixed state;

Where it is the subject of a patent in force, and is supplied in the state required by the specification of the patent;

Where British, colonial, or foreign spirits are reduced from their ordinary strength by persons licensed and paying duties under the excise;

Where a drug is compounded either in conformity with a prescription of a registered medical practitioner or otherwise, according to the usage of trade;

Where the article is unavoidably mixed with some extraneous matter.

7. No person shall sell any article mixed for any of the purposes mentioned in the exceptions above set forth, if the matter mixed be more than is ordinarily required for the purpose, under a penalty of *ten* pounds.

No person shall sell any article of food which by the usage of trade is sold in a mixed state, unless the ingredients shall be mixed in the proportions required by such usage, and no person shall sell any compounded drugs, except the same shall be compounded according to the prescription in writing submitted for that purpose, or in accordance with the regulations prescribed by the British Pharmacopœia issued by the General Medical Council, or with a basis to be laid down by the Pharmaceutical Society, or the Local Government Board, or the Privy Council, subject to a penalty of *twenty* pounds.

8. Provided that no person shall be guilty of an offence in respect of the sale of an article mixed with any ingredient not injurious to health, whether the case may or may not fall within any of the above mentioned exceptions, if at the time of delivering such article he shall supply to the person receiving the same a notice to the effect that the article is mixed, by a label written or printed on or with the article.

9. No person shall knowingly, and with the intent that the same may be sold in its altered state without notice, abstract from an article of food any part of it so as to affect injuriously its quality, substance, or nature, and no person shall knowingly sell any article so altered without making disclosure of the alteration, under a penalty in each case of *ten* pounds.

Appointment and Duties of Analysts, and Proceedings to obtain Analysis.

10. In the City of London and the liberties thereof, the commissioners of sewers of the City of London and the liberties thereof, and in all other parts of the Metropolis the vestries and district boards acting in execution of the Act for the better local management of the Metropolis, the court of quarter sessions of every county, and the town council of every borough having a separate court of quarter sessions, or having under any general or local Act of Parliament or otherwise a separate police establishment, may, as soon as convenient after the passing of this Act, where no appointment has been hitherto made, and in all cases as and when vacancies in the office occur, and when required so to do by the Local Government Board, shall, for their respective city, districts, counties, or boroughs, appoint one or more persons possessing competent knowledge, skill, and experience, as Analysts of all articles of food and drugs sold within the said city, metropolitan districts, counties, or boroughs, and shall pay to such Analysts such remuneration as shall be mutually agreed upon, and may remove him or them as they shall deem proper; but such appointments and removals shall at all times be subject to the approval of the Local Government Board, who may require satisfactory proof of competency to be supplied to them, and may give their approval absolutely or with modifications as to the period of the appointment and removal, or otherwise.

11. The town council of any borough may agree that the analyst appointed by any adjoining borough or for the county in which the borough is situated, shall act for their borough during such time as the said council shall think proper, and shall make due provision for the payment of his remuneration, and if such Analyst shall consent, he shall during such time be the Analyst for such borough for the purposes of this Act.

12. Any purchaser of any article of food in any district, county, city, or borough where there is any Analyst appointed under this or any Act hereby repealed shall be entitled, on payment to the Analyst, or if there be no such Analyst then acting for the district to the Analyst of a neighbouring district, of a sum not more than ten shillings and sixpence, as shall be agreed upon between such person and the Analyst, to have such article analysed by such Analyst, and to receive from him a certificate of the result of his analysis.

13. Any medical officer of health, inspector of nuisances, or inspector of weights and measures, or any inspector of a market, or any police constable under the direction and at the cost of the local authority appointing such officer, inspector, or constable, may procure any sample of food, or drugs, and if he suspect the same to have been sold to him contrary to any provision of this Act, shall submit the same to be analysed by the Analyst of the district or place for which he acts, and such Analyst shall with all convenient speed analyse the same and give a certificate to such officer, wherein he shall specify the result of the analysis.

14. The person purchasing any article with the intention of submitting the same to analysis shall, after the purchase shall have been completed, notify to the seller or his agent selling the article his intention to have the same analysed by the Public Analyst, and shall offer to divide the article into three parts to be then and there separated, and each part to be marked and sealed, or fastened up in such manner as its nature will permit, and shall, if required to do so, deliver one of the parts to the seller or his agent.

He shall afterwards retain one of the said parts for future comparison, and submit the third part, if he deems it right to have the article analysed, to the analyst.

15. If the seller or his agent do not accept the offer of the purchaser to divide the article purchased in his presence, the Analyst receiving the article for analysis shall divide the same into two parts, and shall seal or fasten up one of those parts, and shall cause it to be delivered, either upon receipt of the sample or when he supplies his certificate to the purchaser, who shall retain the same for production in case proceedings shall afterwards be taken in the matter.

16. If the Analyst do not reside within two miles of the residence of the person requiring the article to be analysed, such article may be forwarded to the Analyst through the post office as a registered letter, subject to any regulations which the Postmaster General may make in reference to the carrying and delivery of such article, and the charge for the postage of such article shall be deemed one of the charges of this Act or of the prosecution, as the case may be.

17. If any such officer, inspector, or constable, as above described, shall apply to purchase any article of food

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any drug exposed to sale, and shall tender the price for the quantity which he shall require for the purpose of analysis, not being more than shall be reasonably requisite, and the person exposing the same for sale shall refuse to sell the same to such officer, inspector, or constable, such person shall be liable to a penalty of *five* pounds.

18. The certificate of the analysis shall be in the form set forth in the schedule hereto, or to the like effect.

19. Every Analyst appointed under any Act hereby repealed or this Act shall report quarterly to the authority appointing him the number of articles analysed by him under this Act during the foregoing quarter, and shall specify the result of each analysis, and such report shall be read at the next meeting of the authority appointing such Analyst.

Proceedings against Offenders.

20. When the Analyst having analysed any article shall have given his certificate of the result, from which it may appear that an offence against some one of the provisions of this Act has been committed, the person causing the analysis to be made may take proceedings for the recovery of the penalty herein imposed for such offence, before any justices having jurisdiction in the place where the article or drug sold was actually delivered to the purchaser, in a summary manner.

Every penalty imposed by this Act shall be recovered in the manner prescribed by 11 & 12 Vict., c. 43, and may be mitigated according to the judgment of the justices.

21. At the hearing of the information in such proceeding the production of the certificate of the Analyst shall be sufficient evidence of the facts therein stated, unless the defendant shall require that the Analyst shall be called as a witness, and the parts of the articles retained by the person who purchased the article shall be produced, and the defendant may, if he think fit, tender himself and his wife to be examined on his behalf, and he or she shall, if he so desire, be examined accordingly.

22. The justices before whom any complaint may be made under this Act may, upon the request of either party, in their discretion cause any article of food or drug to be examined and analysed by the Analyst of an adjoining district, who shall thereupon make the analysis as if he were applied to by any officer in his district, and may be required to attend to give evidence at the hearing of the case; and the expense of such examination, analysis, and attendance shall be deemed part of the expenses of executing this Act, unless the justices order the same to be paid by the complainant or the defendant.

23. Any person who has been convicted of any offence punishable by any Act hereby repealed or this Act by any justices may appeal to the next general or quarter sessions of the peace which shall be held for the city, county, town, or place wherein such conviction shall have been made after the expiration of ten days from the day when such conviction shall take place, provided that such person enter into a recognisance within three days next after such conviction, with two sufficient sureties, conditioned to try such appeal, and to be forthcoming to abide the judgment and determination of the court at such general or quarter sessions, and to pay such costs as shall be by such court awarded; and the justices before whom such conviction shall be had are hereby empowered and required to take such recognisance; and the court at such general or quarter sessions are hereby required to hear and finally determine the matter of such appeal, and may award such costs to the party appealing or appealed against as they shall think proper.

24. In any prosecution under this Act, where the fact of an article having been sold in a mixed state has been proved, if the defendant shall desire to rely upon any exception or provision contained in this Act, it shall be incumbent upon him to prove the same.

25. If the defendant in any prosecution under this Act prove to the satisfaction of the justices or court that he sold the article in the same state as when he himself purchased it, and that he bought it, as the same article in nature, substance, and quality as that demanded of him, and with a warranty in writing to that effect, he shall be discharged from the prosecution, but no order for costs shall be made in the case, unless he shall raise any other question which shall be decided against him, in which case he shall be liable to pay the costs incurred by such question.

26. Every penalty imposed and recovered under this Act shall be paid in the case of a prosecution by any officer, inspector, or constable, to the prosecutor, and shall be by such prosecutor paid to the authority for whom he acts, and be applied towards the expenses of executing this Act.

27. Any person who shall forge, or shall utter, knowing it to be forged for the purposes of this Act, any certificate or any writing purporting to contain a warranty, shall be guilty of a misdemeanour, and be punishable on conviction by imprisonment for a term of not exceeding *two* years with hard labour.

28. Nothing in this Act contained shall affect the power of proceeding by indictment, or take away any other remedy against any offender under this Act, or in any way interfere with contracts and bargains between individuals, and the rights and remedies belonging thereto.

Expenses of Executing the Act.

29. The expenses of executing this Act shall be borne in the city of London and the liberties thereof, out of the consolidated rates raised by the Commissioners of Sewers of the City of London and the liberties thereof, and in the rest of the metropolis out of any rates or funds applicable to the purposes of the Act for the better local management of the metropolis, and in counties out of the county rate, and in boroughs out of the borough fund or rate.

Special Provision as to Tea.

30. From and after the first day of January, one thousand eight hundred and seventy-six, all tea imported as merchandise into and landed at any port in Great Britain or Ireland shall be subject to examination by persons to be appointed by the Commissioners of Customs for the inspection and analysis thereof, for which purpose samples may, when deemed necessary by such inspectors, be taken and with all convenient speed be examined by the Analysts to be so appointed; and if upon such analysis the same shall be found to be unwholesome, mixed with other substances or exhausted tea, the same shall not be delivered unless with the sanction of the said Commissioners, and on such terms and conditions as they shall see fit to direct, either for home consumption or for use as ships' stores or for exportation; but if on such inspection and analysis it shall appear that such tea is, in the opinion of the Analyst, unfit for human food, the same shall be forfeited and destroyed or otherwise disposed of in such manner as the said Commissioners may direct.

31. Tea to which the term "exhausted" is applied in this Act shall mean and include any tea which has been deprived of its proper quality, strength, or virtue by steeping, infusion, decoction, or other means.

32. This Act shall commence on the *first day of October, one thousand eight hundred and seventy-five.*

33. This Act may be cited as "The Sale of Food and Drugs Act, 1875."

The second reading of this Bill was moved by Mr. Sclater-Booth. The right hon. gentleman said that the first Act upon this subject was passed in 1860, and was rendered necessary by the frequent complaints of purchasers from retail tradesmen of the injury to which they were subjected by the prevalence of adulteration. That Act was in operation for twelve years, when it was entirely recast under the auspices of his noble friend near him, and the question was mixed up in a great degree with sanitary considerations. In the second Act the

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appointment of an analyst was made *quasi*-compulsory on the authorities who had to do with it, and the law had a sanitary object. The language or the Act was founded on the idea of adulteration, which was to be prohibited, not only because it was a fraud upon the purchaser, but also because it was an injury done to the community. But this Act was soon found to be attended in its working with serious difficulties, partly caused by the want of any definition of the word "adulteration" in the Bill. Judges differed, and magistrates were unable to understand what was exactly meant by the word. Again, there were some obscurities in certain operative clauses of the Bill which brought about failure on the one side, and on the other gave rise to serious heartburnings. When he came into office, therefore, he found that though the Act was of so recent a date the time had arrived for re-considering it. Consequently, about a year ago, he asked the House to appoint a Select Committee with a view to some amendments during the last Session of Parliament. He stated to the House at that time that his object in proposing the Select Committee was to mitigate the hardships which were undoubtedly imposed on traders in many cases by the law as it stood, but still more to facilitate and make plain the operation of the law, so that the advantages which the public unquestionably possessed by the existence of those Acts might be preserved to it unimpaired. The report was not in his hands early enough to enable legislation to be pressed on last year. Having to consider the matter during the recess, the first question was whether the new Bill should be laid down on the same lines as the old, and whether the same language should be used in its operative clauses. The experienced draughtsman to whom the preparation of the Bill was entrusted found it impossible with satisfaction to himself, or with any assistance which he (Mr. Sclater-Booth) could give, to frame such a definition of the word "adulteration" as could be relied upon as the basis of permanent legislation on the subject. The consequence was, that what would be regarded as the operative clauses of the Bill had been drawn up in a different way, and an attempt had been made to lay down in the clauses the things exactly prohibited, and the exceptions which might fairly release the trader from penalty. The Bill was arranged in five parts; it described the offences prohibited, laid down rules for the appointment and duties of analysts, and regulated the proceedings against offenders; then there were some special provisions with regard to certain offences, and some important clauses with reference to the new duties imposed on those who were to carry out the measure. It prohibited the admixture with food and drugs of any ingredient injurious to health, or the sale of any article not of the nature demanded by the purchaser, with certain exceptions. It was provided that if articles were mixed, whether in accordance with the custom of trade or the convenience of the consumer or seller, they should be mixed in proper proportions, and it would be for the seller to show that. Under the old Act, the seller of retailed articles was obliged to declare orally to his customers if there had been any admixture. That provision had been seriously complained of, and it was obvious that in any shop where a large business was done, this express notice could not be given or insisted on. It was therefore now proposed that it would be sufficient if a label stating the fact was affixed to the article. The Select Committee had recommended that the appointment of analysts should be made compulsory on the authorities. But there were objections to such a course. In the first place the number of candidates for these appointments were not very considerable, and great difficulty had been experienced in getting competent analysts. Then, though you might make an authority appoint an officer, you could not without stringent legislation make him put the officer in motion. He knew from the experience he had in other branches of administration how easy it was to make a colourable appointment and then to take care that the person appointed should not do that which the law contemplated. Further, he did not think it advisable that the appointments should be too numerous if a smaller number would be sufficient. It was clearly desirable that a small borough, for instance, should have inducements held out to appoint the same person as had been appointed to a large borough or town in the same county to discharge the duties rather than to have separate analysts for each separate town. A refusal on the part of a dealer to allow samples of his goods to be taken for analysis was made a punishable offence. As a matter of common justice, the dealer and his wife would be admitted to give evidence at their trial. This led him to a provision to which he had given anxious consideration—namely, that if the defendant in any prosecution produced a warrant of the purity of the article from the person of whom he had bought it, and also proved to the satisfaction of the justices that he sold it in the same state as when it came into his hands, he should be discharged. Proceedings, however, might be taken against the person who had given such a warrant in the event of the article proving to be adulterated. The fines obtained from prosecutions would in future go to the authorities who were charged with the carrying out of the Act, instead of to the police, and it was hoped that this would prove an inducement to those authorities to have the provisions of the Act strictly enforced. There was an important provision that tea should be examined by the Customs on importation. Any tea pronounced by the Customs' analyst to be unfit for human consumption would be forfeited and destroyed. Altogether, he believed that if the Act was properly enforced the adulteration of food and drugs would be reduced within very narrow limits. Already analysts had been appointed in 34 out of 54 counties, and he had no doubt that under the present Bill the number of such appointments would be largely increased. The Committee were strongly of opinion that mixtures of coffee, cocoa, mustard, &c., which were expressly labelled as mixtures, should be allowed for the sake of the public taste, and their recommendation on this point had been adopted in the Bill. If the consumer desired those articles mixed, and they were harmless, there seemed no reason for prohibiting their sale. At prosecutions it would not be necessary for the analyst to attend unless his presence was expressly desired, and samples for analysis might be sent through the post. A body of gentlemen representing the public analysts had, he was happy to say, expressed approval of the general principles of the Bill, though of course they had suggestions to make in their own interest, some of which he should be able to accept. He hoped the local authorities would take steps to secure prompt execution of the Bill in case it passed into law, and at the same time to ensure fair hearings for all persons concerned in cases of prosecution. He believed the provisions contained in the measure would tend to the great advantage of the public, and would at the same time do no real harm to the trading classes. All the clauses of the Bill had been carefully drawn and considered with a sole desire to provide an effective security for the purchasing public, and at the same time to remove what was a reproach to the existing law—namely, that it was gratuitously injurious to the trading classes. The right hon. gentleman concluded by moving the second reading of the Bill.

Mr. Sandford thought this Bill was framed rather in the interest of the wholesale dealer than in the interest of the public. Under the present Act adulteration had been reduced to a *minimum* quantity; but if they were going to return to the old state of things, and to require knowledge on the sale of adulterated articles, then he said they were going to re-establish the state of things which existed twenty-two years ago, and which shocked the public when it was exposed before the Committee that sat. He was quite sure his right hon. friend would be only too anxious to attend to any suggestions that might be made. He would venture to put on the paper some suggestions, and he had only to request that his right hon. friend would not fix too early a day for going into Committee on this Bill.

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Mr. Muntz observed that the Bill contained a clause specially providing that the Bill should not apply to Scotland or Ireland. He could not understand why that clause was inserted. The working of the Act seemed to give satisfaction in Ireland. Dr. Cameron, the Analyst for Dublin, was decidedly in favour of the Act; and if he remembered right that gentleman stated that before the Act was put in operation in Dublin to every gallon of milk was added 2 gallons of water, but that since the Act came into operation, the water had disappeared, and the milk was perfectly sound. There was in the Bill another clause which provided that if a defendant proved he had sold the article in the same state in which he had purchased it, and with a warranty in writing to that effect, he should be discharged. The recommendations of the Committee were, that if a warranty in writing were produced by a defendant the case should be adjourned, and that the justices should direct a summons to be issued against the person or persons from whom the defendant had purchased the articles, who, if found guilty of adulteration, should be liable to the penalties imposed. For his own part, he could see no objection to the insertion of a clause embodying those recommendations of the Committee. Certainly the wholesale dealer ought to be held responsible if it were clearly proved that the retailer purchased the articles of him in an adulterated state. If this alteration were made in the Bill it would be a most valuable one.

Mr. Pell said that, under the 10th clause, 10s. 6d. was the outside sum to be paid by a person who required an analysis, and this charge, he maintained, was far too low. He should propose an amendment to remove this *maximum* amount to be paid for an analysis.

Sir H. Peek said he had been in the tea trade all his life, and he believed that not one ounce in a ton of all the tea which came into England was adulterated here. The examination of tea by sample might be very easily effected. Five samples taken from 1000 lbs. weight would be quite sufficient, and if one of those samples was found to contain matters injurious to the human organs it would not be difficult to ensure its destruction. When the proper time arrived he should be able, on the part of the trade, to show how the bill might be considerably improved.

Mr. Garnier wished to express his opinion that this Bill would remedy all the grievances of traders, while it gave increased protection to the public. As to the Act of 1872, it was practically a dead letter in the country districts, because the inspectors, who were generally superintendents of police, could not be spared from their other duties to take the samples to the Analyst for examination.

Mr. Read assured the House that the Bill was meant to extend also to Ireland and Scotland, and that that fact would be made, if it did not now, to appear plainly on the face of the Bill in Committee.

Dr. Lyon Playfair—I am perfectly sure that the intention of the Government, in framing this Bill, was to make the law thoroughly just and good. There were two interests which they had to consider. They found that the Act had produced some hardship to trade, and that it also proved, in some respects, injurious to the public. The Acts of 1860, 1867, and 1872 have been very beneficial to the public. Before the Act of 1872 was passed, the usage of the trade, with respect to some of the great staple articles of food, was in a very unsatisfactory state. The ordinary usage of the milk trade was to place 25 per cent of water in milk, while at the same time milk did not contain any substance that was prejudicial to health. That usage was condemned, and now milk can be obtained without any adulteration. Again, the usage with regard to bread was to place alum in flour, and to sell bread to the poor of a very inferior quality made of the adulterated flour. The law has compelled bakers to sell to the poor bread which is pure in quality, and from which they can obtain proper sustenance. The operation of the Acts also drove tea, which was imported in an adulterated condition, to other markets, and required that coffee and mustard, which before had been very much mixed should when mixed, be labelled; so that the purchaser might at all events know what he was buying. Vinegar, too, which before the passing of the Act was much adulterated, is now to be had in a pure condition. Therefore, as regards some great staple articles of food, very important results have been obtained through the operation of the Acts which have been already passed. Now, what I want the House for a moment to consider is this: Does this Bill, while it relieves traders from certain hardships under which they have laboured, secure to the public the benefits they have derived from the Acts to which I have alluded? My own impression is that it does not, and that, unless it is very greatly altered in Committee, while some of the hardships of which traders have complained will be removed, the public will lose the benefits which they have derived from past legislation. I will now, with the permission of the House, point out some of the clauses which induce me to think that much more serious protection of the public is required than is given by this Bill. I venture to say that this Bill differs very essentially from the Acts of 1860, 1867, and 1872. In all these Acts it was assumed that persons selling articles had a sufficient acquaintance with their business to know whether what they offered to their customers was pure or impure; and by the 24th section of the Act of 1867 it was enacted that the knowledge of the adulteration was to be assumed, unless the contrary were proved by the seller. The seller was deemed to know what he was selling; the responsibility for adulteration was made to rest upon him. There have been several judgments in courts of law in accordance with that view. I will only refer to one of them. Mr. Justice Blackburn laid down this principle in a case of appeal with regard to an adulteration of butter, that the simple fact of an article being sold as butter threw on the seller the responsibility of first ascertaining whether it contained lard or any other article as well as butter. In fact, the whole of the judgments given by the superior courts in reference to such matters assumed that the seller ought to know his business sufficiently to be aware whether an article was adulterated or not. Now, what does the Bill say on this point? It says, in effect, that ignorance, instead of knowledge, is to be assumed. The question raised by the word "knowingly" comes in all through the Bill. A man is to be punished who "knowingly" sells a thing that is adulterated, so that he can save himself by not knowing his business at all. A man need not know his business, whatever it may be. If he sells milk, he need not know whether it contains cream or not; he need not know whether he is selling pure milk or skim milk. For my part, I fear that the use of this word "knowingly" will neutralise, to a great extent, the benefit intended to be secured by the Bill; for how can you establish the fact that the thing was done "knowingly?" A man who undertakes to sell food to the people ought to know whether he sells food or not; but how can that be the case unless he is an expert in the business in which he is engaged? Therefore, I think the introduction of the work "knowingly" is a serious defect in the Bill. Another thing which will enable a seller to drive a coach and four through the Bill is the use made in it of the words "usage of trade." What is the "usage of trade"? Before the Acts to which he had alluded came into operation, it was a usage of trade to sell 25 per cent of water as milk, though in London and many other places milk was sold at a very high price. Again, take the case of drugs. It was the usage of trade to send drugs in the root to the drug-grinder, and, when the drug-grinder sent them back, for the owner to receive exactly the same weight of drugs as there was before. The drug-grinder charged nothing for what he had done. How was the grinder paid? Why, by subtracting a certain proportion of the genuine article, and substituting for it some adulterating substance. That usage was swept away under the operation of the Acts which I have mentioned, but under the term "usage of trade" it may be revived. It was a usage of trade to mix oil of vitriol with vinegar, in order to strengthen it by means of such adulteration. Under the operation of the old

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Acts, that usage was destroyed; but, if the Bill passes without amendment on this point, we may see it again. It was a usage of trade to put alum in bread, and I believe that that usage is not unlikely to be renewed if the Bill is not amended. In fact, under the phrase "usage of trade," people would be enabled to drive a coach and four through any part of the Bill; and, unless you alter the Bill in that respect, you will render legislation nugatory, so far as the interests of the public are concerned, whatever may be its effect as regards the interests of the trader. The hon. member for Leicestershire (Mr. Pell) has, I think, hit a blot in the Bill. It is impossible to get a chemical analysis such as is required under this Bill for 10s. 6d., and therefore it would be more correct to say that the consumer would have a right to go and get analysis at the expense of the ratepayers. It would be necessary to have combined areas, with efficient Public Analysts receiving salaries of from £100 to £200 a year; and it would be more accurate to say that the cost of the analysis would be 10s. 6d. *plus* the salary drawn from the ratepayers and paid to the Analyst. My hon. friend the member for Norfolk (Mr. C. S. Read) has stated that, when the Bill was prepared, it was intended that Scotland and Ireland should be included in its operation. The Bill, however, expressly says that nothing in the Act shall apply to Scotland or Ireland, "except as hereinafter provided;" and I find nothing provided in the Bill on the subject. At present, Scotland and Ireland are left out in the cold, although they have derived great benefit from the old measures; but I am sure that a provision will be made in the Bill to remedy any such inconvenience.

Mr. Sclater-Booth—Although I have no right to reply, and I have no wish to question any observations which have been made, yet I trust that I may be allowed to make one or two observations. With regard to the observation of the honourable member for Stafford (Mr. Salt), that the poor man is not considered in this Bill, and that he will not be able to pay an Analyst ten and sixpence for an analysis, of course that is so; but under the provisions of the Bill the police and the public prosecutor of the locality are in duty bound to take care of him in the same way that they are required to see to the due inspection of weights and measures. I am not surprised that many honourable members have commented upon and taken exception to Clause 6, which refers to the usages of trade. I accepted that clause with considerable hesitation, and I will carefully consider whether that which I wish to provide for, and which is the real object of the Bill, is not sufficiently provided for by a subsequent clause. I must admit that the word "knowingly" is used too frequently, and I think that there are two places where it ought to be struck out. It certainly was not intended that this Bill should take from persons in Ireland any advantages they enjoyed before. My honourable friend the member for Leicester has complained that, in addition to the charge of ten shillings and sixpence for analysis, there is a supplementary charge to be raised out of the rates. Well, I cannot help thinking that if any charge on the rates is reasonable, it is a charge of this nature. A single prosecution may have the effect of purifying the practice in the whole town, and on that account it seems to me that if there is any charge that should be made on the rates, this is one. I can assure the House that the various suggestions which have been offered will be all considered by me with the fairest possible spirit, and with every anxiety to make the Bill as perfect as possible. I shall be prepared for some changes. The honourable member for Kendal (Mr. Whitwell) asked me what is proposed to be done under the eighth clause? but I should like to communicate with the Customs before I answer that question.

Dr. Lyon Playfair—Will the right honourable gentleman state when he intends to go into Committee?

Mr. Sclater-Booth—Yes; I would ask the House to go into Committee on Friday next, but if that is too soon I would propose Thursday week.

The Bill was then read a second time, and ordered to be committed on the 4th of March.

CORRESPONDENCE.

ADULTERATION OF FOOD AND DRUGS ACT.

To the Editor of the Chemical News.

Sir,—In the new "Adulteration of Food and Drugs Act," there is one point to which I think the attention of analysts ought to be particularly called, with a view to obtaining its alteration in committee; since, if allowed to remain in its present form, it would be unjust towards the analysts (appointed under the old Acts), and also towards the authorities appointing them. I refer to these words occurring in Clause 12 "or if there be no such analyst then acting for the district, to the analyst of a neighbouring district." With the exception of these words, there is no objection to the clause, which runs thus: "Any purchaser of any article of food in any district, county, city, or borough, where there is an analyst appointed under this or any Act hereby repealed, shall be entitled on payment to the analyst, *or if there be no such analyst then acting for the district, to the analyst of a neighbouring district*, of a sum not more than ten shillings and sixpence, as shall be agreed upon between such person and the analyst, to have such article analysed by such analyst, and to receive from him a certificate of the result of his analysis."

An analyst being paid a salary by a certain county or borough, and in consideration of such payment agreeing to perform all analyses of food or drugs purchased in that county or borough, at a fee much below that usually charged, is it fair to the authority appointing the analyst that persons purchasing food in a county or borough, which contributes nothing towards his salary, should, nevertheless, be able to employ him at the reduced scale of charges applicable to his own district? or is it fair to the analyst himself that he should be required to make analyses for a district with which he has no connection on the same terms as for that from which he receives a salary? If such is to be the case, then those districts which do not think fit to appoint their own analysts will be able to get their work done at the expense of their neighbours who have already done so; and an analyst holding one appointment will be pretty much at the mercy of those counties or boroughs in his neighbourhood which do not choose to make appointments for themselves.

If the words are to remain in the clause, then every county and borough ought to be compelled to make its own appointment, and be allowed to call in the analyst of a neighbouring district only in cases of emergency.

Clause 22 is also objectionable. Surely an analyst should be at liberty to refuse, if he thinks fit, any analysis not coming from his own district; and when he does accept it, is it not quite unreasonable to expect him to do it at a maximum charge of ten shillings and sixpence?

The first object of an act for preventing adulteration should be to secure thoroughly competent and trustworthy analysts, not to obtain the greatest possible amount of work for the smallest possible amount of money, which seems to be the aim of the new act. The only result to which such an attempt can lead is gradually to fill up the appointments with inferior, if not altogether incompetent, men—to introduce slipshod, rough and ready (and consequently inaccurate) processes into the laboratories of public analysts, and to bring both the law and science into discredit and contempt.—I am, &c.,

An Analyst.

THE AMMONIA SODA PROCESS.

To the Editor of the Chemical News.

Sir,—Being desirous of adopting the ammonia process in the manufacture of soda, I take the liberty of asking you

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if you would be kind enough to inform me in what publications (serial or otherwise) I could meet with a description of the process and of the necessary plant.—I am, &c.

Henry Charles Platts.

Nevsky Prospect, No. 11, St. Petersburg.

NOTICES OF BOOKS.

A Manual of Hygiene, Public and Private. By C. A. Cameron, Ph.D., M.D., &c. Dublin: Hodges, Foster, and Co. London: Baillière, Tindall, and Co.

Dr. Cameron has here presented us with a goodly volume, embracing nearly all subjects bearing upon public health. He treats of the duties of sanitary authorities and health officers; of nuisance; of vital statistics; of water supplies, the composition and examination of purification and softening of water; of bad water as a cause and carrier of disease; the quality of the water in Irish towns; on normal and abnormal air, &c. On all these subjects, his own extensive experience as a Public Analyst and Health Officer has been supplemented by abundant and judicious reading, and, as far as we are in a position to judge, the information which he gives is, as a rule correct.

As we have on various occasions attempted to do, he warns the public against supposing that further sanitary reforms are not required. After touching on the epidemics of the middle ages, he adds—"I wish to direct attention to these almost forgotten calamities, because they are calculated to teach us important lessons. Are we sure that we are safe from another visitation of the 'black death'? There are epidemiologists who believe that the germs of this disease still linger among the deep valleys of the Himalaya, and that they may yet be wafted to Europe. If such an event should ever unfortunately take place, I fear that in some of our towns the virus of the disease would find a genial soil."

We heartily concur with the view expressed in the following passage:—"The Medical Officer should never conduct a prosecution, nor appear in court in any other capacity than that of a skilled witness." This applies with equal force to Public Analysts, some of whom, as was pointed out at one of the meetings of their Society, have gone astray in assuming something too much resembling the duties of a prosecuting solicitor.

In case of exhalations from chemical works, the Health Officer is advised to "be slow to suggest a remedy." If it proves a failure, as may easily be the case with the suggestion of one not specially conversant with the process carried on, the magistrates will be little disposed to take his advice in future.

As regards the supply of water, Dr. Cameron speaks favourably of the Welsh lakes, which certain projectors view as an ultimate source whence London may be furnished. We fear, however, that all such waters, freely exposed to light and warmth, will, during the summer season, be found to contain organisms. Nor can we approve of Mr. Bailey Denton's plan of collecting the drainage from sub-soils at the depth of about 4 feet. Such water must be identical with that furnished by shallow wells, of which we have seen quite sufficient. As regards the analysis of potable waters, we find that, like all chemists who have taken up this subject in a really practical manner, he gives the decided preference to the process of Wanklyn, Chapman, and Smith. He cites a water from a public pump at Waterford containing, per gallon, 4·06 grains of free ammonia and 0·4 of organic nitrogen! This is equal to many kinds of sewage.

The question as to the comparative value of hard and soft waters for dietetic purposes is brought forward, but the evidence is too conflicting to allow of a decision. The high death rates of Manchester and Glasgow may be explained without the supposed injurious action of soft water.

In the section on the propagation of disease by means of water, the author states, on the authority of Dr. Ballot, of Rotterdam, that in Holland, in places where rain-water was in general use, the disease was by far less violent. How does this agree with the few, that the poison of epidemics is conveyed in the atmosphere?

Under the head of nuisances arising from manufactures, we find, curiously enough, no mention of the sulphurous acid generated in the combustion of coal. The soap manufacture retains a bad name from old times, when the soap-boiler received crude fats mixed with impurities from the slaughter-house. But no factory can be freer from nuisance than a modern soapery, which consumes merely palm and olive oils, refined tallows, oleic acid, &c.

Amongst the disinfectants, we find no mention of "Cooper's salts"—a mixture of the chlorides of magnesium and calcium—certainly not the least efficacious.

In speaking of sewage processes, the author makes the bold statement that "the A B C system, which consisted of adding alum, blood, and clay (he should have added, and charcoal) to the sewage, has failed." That this process has failed in a sanitary point of view we most emphatically deny, and we regret that Dr. Cameron has not taken the trouble to examine this matter personally before coming to such a decision. If the A B C process has not yet proved commercially lucrative, it has but shared the common fate of all sewage processes, irrigation by no means excepted.

The unfortunate Select Parliamentary Committee on the Adulteration of Food, and its "Report," are dealt with in a very lenient manner, and their glaring sins are overlooked.

We might devote a much greater space to this volume, and might multiply interesting extracts almost indefinitely, but we prefer to refer sanitarians to the work itself. They will find it a useful, comprehensive, and generally trustworthy *vade-mecum*.

Jahresbericht uber die Fortschritte auf dem Gebiete der Reinen Chemie. Von Dr. Wilh. Staedel. Tubingen: Laupp.

This volume is the first issue of a valuable yearly periodical, giving a summary of progress in the department of pure chemistry. The work is divided into three sections, embracing respectively inorganic, organic, and theoretical and physical chemistry. The applications of chemistry to other sciences, or to practical purposes, are not included in the plan of the learned editor. Analytical methods and improvements have also been excluded, in view of the excellent and universally known quarterly publication of Dr. Fresnius. So far as we have been able to examine the volume before us, it gives a fair, clear, and tolerably full account of all researches and discoveries in pure chemistry, with references at the foot of the page to the original documents in the proceedings of learned societies, and in the scientific journals of the Continent, of Britain, and of America. We have no doubt that this annual will be extensively useful, and we wish the author the fullest success.

Preis-Courant der Fabric fur Alcohol Præparate von C. A. F. Kahlbaum, *Berlin.*

The very existence of an establishment like that of Mr. Kahlbaum, devoted to the manufacture and sale of preparations of the alcohols and their derivatives is a proof of the wonderful development which chemistry has recently experienced. We find here a price list of upwards of 220 compounds belonging to the methylic, ethylic, propylic, butylic, and amylic series, besides others pertaining to the aromatic series, and the announcement that other substances of the same class may be had to order. Amongst the rare and curious preparations here quoted we may instance sulphurea, anhydrous methylamin, anhydrous trimethylamin, nitroethan ethylphosphiniodhydrate, with diethyl and triethylphosphin, isobutylsulphydrate, resorcin, acetonitril, diethylamin, &c. To the experimental chemist it is a great and a novel advantage to be able to procure such substances.

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SUPPLEMENT
TO
THE CHEMICAL NEWS.
VOL. XXX. No. 796.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 18th, 1875.

Professor ODLING, F.R.S., President, in the Chair.

THE names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, the following names were read for the first time—Messrs. A. Taylor, M. G. Crossman, C. A. Heywood, S. A. Hill, E. L. Cleaver, R. E. Cumington, and C. O'Keeffe. For the third time—Messrs. Henry John Yeld, Henry Shepheard, Joseph William Thomas, Arthur Madge, Walter Saise, James Sanders Merry, C. H. Aldred, William James Lancaster, Charles C. Connor, and John William Biggart, who were balotted for and duly elected.

The PRESIDENT, in accordance with the bye-laws, then announced the proposed changes in the council and officers of the Society for the ensuing year, after which he called on Professor CLERK MAXWELL to deliver his lecture "*On the Dynamical Evidence of the Molecular Constitution of Bodies.*" The Lecturer began by defining an explanation, stating that they might be of various orders, but that, as yet, we have not a complete dynamical explanation of so-called chemical phenomena. In studying the constitution of bodies we deal with particles which we cannot observe, for whatever may be our ultimate conclusions as to molecules and atoms, we have experimental evidence that bodies may be divided into parts so small that we cannot perceive them. The next thing required is a dynamical method of studying a system consisting of an immense number of particles, and the application of this method to molecular studies. This special adaptation has been to a great extent the work of Professor Clausius, of Bonn, whose equation

$$pV = \tfrac{2}{3}T - \tfrac{1}{3}\Sigma\Sigma(\tfrac{1}{2}Rr) \qquad (1)$$

has furnished us with a new dynamical idea. Here p is the pressure of a fluid, and V the volume of the vessel which contains it. Vp, in the case of gases, is nearly constant, as Boyle's law tells us, and is the product of two quantities which can be directly measured. T is the kinetic energy of the system, and since the kinetic energy of a particle is half the product of its mass into the square of its velocity we may write the equation in the form

$$pV = \tfrac{1}{2}Mc^2 - \tfrac{1}{3}\Sigma\Sigma(\tfrac{1}{2}Rr) \qquad (2)$$

where M is the mass and c the mean velocity. In the second term r is the distance between any two particles, and R the attraction between them. The quantity $\frac{1}{2}Rr$ is called by Clausius the "Virial" of the attraction, $\Sigma\Sigma$ being their sum. From this it follows that the pressure of a fluid must be due wholly, or in part, to the motion of its particles, and not to a repulsion between them, since in the latter case the repulsion would be inversely as the distance, a law which Newton has shown to be inadmissible in the case of molecular forces. If we suppose the particles not to act on each other at all, the equation will become

$$Vp = \tfrac{1}{2}Mc^2 \qquad (3)$$

and as it may be proved that c^2, the mean square of the velocity, depends only on the temperature, this equation exactly represents Boyle's law. Most ordinary gases however, deviate from this law, and this deviation may be accounted for by the action of the forces between the particles. In a rarefied gas the number of particles within a given distance of any one particle will be proportional to the density of the gas, or the whole virial will vary as the square of the density ρ^2. Dividing (2) by V we get

$$p = \tfrac{1}{2}\rho c^2 - \tfrac{1}{3}A\rho^2 \qquad (4)$$

where A depends on the temperature. Regnault has shown that as the density increases the pressure falls below that required by Boyle's law. Hence the virial must be positive, and therefore the mutual action of the particles must be in the main attractive. On the other hand, when the pressure becomes still greater the substance at length reaches a state in which an enormous increase of pressure produces but a very small increase of density, indicating that the virial is now negative. The pressure at first depends almost entirely on the motion of the particles, and therefore varies nearly as the pressure, according to Boyle's law. At length, however, the effect of repulsion will prevail over that of attraction, and the pressure will increase so that an exceedingly small increase of density will correspond to an enormous increase of pressure.

The author then discussed the results of Andrews's researches on the pressure at various temperatures, pointing out the change in form of the curve, which corresponds to the "critical point" in the continuity of the liquid and gaseous states.

From the equation of Clausius it is easy to calculate the velocity of the particles, and this is found to be about 465 metres per second for oxygen, and 1859 for hydrogen. The reason why gases do not disseminate themselves through the atmosphere with velocities at all approaching those indicated, is that the molecule, after describing a very short path, encounters other molecules, and then describes a new path. Hence, it is evident that the rate of diffusion depends not on the velocity of the molecules, but on the distance they travel between each encounter.

The lecturer here explained the law of the distribution of velocity among molecules of the same kind as illustrated by a diagram he had prepared for this purpose, from which it appeared that if in the same vessel there are different kinds of molecules, some of greater mass than others, their velocities will be so distributed that the average kinetic energy of a molecule will be the same, whether its mass be great or small. Hence, if we have two gases in the same vessel, if the pressure and temperature be the same, the kinetic energy per unit of volume is the same, and also the average kinetic energy of a single molecule. There must, therefore, be the same number of molecules, in a unit of volume of the two gases, which is the law of equivalent volumes of Gay-Lussac and Avogadro. A molecule is defined as that small portion of the substance which moves as one lump during the motion of agitation. The density of a gaseous medium at standard temperature and pressure is proportional to the mass of one of its molecules as thus defined.

Hitherto, only the motion of the centre of mass of the molecule had been considered; the internal motions of the constituents of the molecule relative to the centre of mass, formed the greatest difficulty in the kinetic theory of gases.

It is not essential to the mathematical investigation to assume that the molecule is made up of atoms, but merely that the position and configuration of the molecule can be completely expressed by a certain number of variables, n, for instance. Of these, three are required to determine the position of the centre of mass, and the remaining $n-3$ determine its configuration relative to the centre of mass.

The kinetic energy of the molecule may be regarded as made up of two parts—that of the mass of the molecule supposed to be concentrated at its centre of mass, and that of the motions of the parts relative to the centre of mass.

The first part is called the energy of translation; the second, that of rotation and vibration. The sum of these is the whole energy of motion of the molecule; and, as the pressure of the gas depends on the energy of translation alone, so the specific heat depends on the whole energy.

Boltzmann has found that for n variables the average energy of translation is the same for molecules of all kinds at the same temperature, the whole energy of motion being to the energy of translation as n is to 3.

After considering the difficulties attendant upon the investigation of the relation between specific heat and the atomic constitution of the molecule, the lecturer said that the most important result of these enquiries was a more distinct conception of thermal phenomena. In the first place, the temperature of the medium is measured by the average kinetic energy of translation of a single molecule of the medium. In two media placed in thermal communication, the temperature, as thus measured, tends to become equal. In the next place, we learn how to distinguish this kind of motion, which we call heat, from other kinds of motion. Its peculiarity consists in being perfectly irregular; it differs, therefore, entirely from such physical phenomena as the transmission of sound, where the motion of the medium during the passage of the sound wave is regular.

The lecturer, in conclusion, by the application of the molecular theory to the luminiferous ether, showed that the latter could not consist of atoms or molecules.

The PRESIDENT said they would all appreciate the difficulty in which a chairman was placed when he had to remark upon a paper of this character; but there was one point which presented no difficulty, that of thanking Professor Clerk Maxwell, who had come amongst them to deliver this useful and interesting lecture. In common with every Fellow present, he could speak as to the instruction and gratification he had derived from the clearly-expressed explanation given of such recondite subjects; he might especially mention the variations from Boyle's law, and the illustration of the insensible transition of matter from one physical state to another. The cordial thanks of the Fellows were due to the Lecturer, and he thought that, to the list of great names connected with the dynamical theory, he might take the liberty of adding that of Clerk Maxwell.

The meeting was then adjourned until Thursday, 4th of March, when there will be papers "On the Chemical Constitution of the Brain, by Dr. Thudichum;" "On the Dissociation of Nitric Acid," by Messrs. P. Braham and J. W. Gatehouse; and "Researches on the Action of the Copper-Zinc Couple on Organic Bodies (No. VIII., on Chloroform, Bromoform, and Iodoform)," by Dr. J. H. Gladstone and Mr. A. Tribe.

The Faraday lecture, "On Liebig's Contributions to Experimental Chemistry," will be delivered by Dr. A. W. Hofmann, F.R.S., on Thursday, 18th March.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 4, January 25, 1875.

Effect Produced by the Application of Armatures to Magnets.—M. J. Jamin.—The author has already indicated (*Comptes Rendus*, lxxviii., p. 1331) the procedure which enables him to calculate the total magnetism of a magnet. He employs magnets, the thickness and width of which are equal respectively to 10 and 50 millimetres; their lengths vary. The armatures are of the same width and thickness; they are adjusted as accurately as possible, and secured by pressure on the extremities of the magnet which they prolong. If a single armature is placed at the northern end of a magnet, it in no wise modifies the magnetic condition of the southern end, which remains bare. If the effect produced on the south side by the application of an armature is considered, it will be found that it takes magnetism which the steel loses, but that this new distribution is no wise modified by putting an armature on the opposite side, or by removing one. Hence, as regards armatures, there is an absolute independence between the two halves of the magnet. This independence proves a capital fact; that the application of an armature to one of the ends of the magnet occasions a new distribution there, but neither decreases nor augments the sum total of the magnetism there present: the steel loses what the armature gains. This points out a method of determining the magnetism of steel as compared with that of soft iron.

Mineral Substances Contained in the Juice of Beet-Root, and on the Potash Extracted.—E. Peligot.—It is well known that the beet, in addition to sugar, contains a great number of matters soluble in water. The author has made some new observations on the juice of this root as regards the mineral salts, which it contains to the extent of 6 to 12-thousandths of its weight. The ashes of the entire beet-root differ in composition from the ashes of the juice. Although the matter which forms the cellular part of the plant is not abundant, the pulp retains in the form of insoluble compounds almost the totality of the calcareous salts which are found in the ash of the root. The turbid juice, obtained by pressing the freshly rasped pulp of beet-root, contains a small quantity of these salts. It rapidly becomes coloured on exposure to the air, and cannot be filtered unless it has been previously boiled for a few moments. The heat renders insoluble all the phosphate and carbonate of lime previously held in solution by means of the carbonic acid, which all vegetable juices contain in abundance. Thus the juice of the beet-root, after ebullition, is free from calcareous salts. Nevertheless, in this state it still contains phosphates, as may be shown by the molybdic process. This phosphoric acid is chiefly found as tribasic phosphate of potash, of which the ash of the juice contains more than the third of its weight. A notable quantity is also present as ammonio-phosphate of magnesia. The ash of the juice contains 10 to 15 per cent of its weight of bibasic phosphate of magnesia. The defecation of beet-root juice is effected in all manufactories by adding to the heated liquid a certain dose of slaked lime. This is always followed by an escape of ammonia, due to the decomposition of the double salt of magnesia and ammonia. The magnesian salt, rendered insoluble by the neutralisation of all acids, forms part of the scum formed mainly by the phosphate of lime derived from the decomposition of the phosphate of potash. This scum is consequently a powerful manure. The carbonate of potash extracted from the residues of the sugar works contains a quantity of phosphate, which occasions at times inconvenience in the glass manufacture. The potash, as well as the sand and red-lead employed, should be as pure as possible. The presence of phosphate renders the glass milky and opalescent.

Researches on Albumenoid Matters.—M. P. Schützenberger.—Having observed a reaction in which albumen and its congeners are split up by mere hydration into products which are almost all crystallisable, and hence more easy to determine, the author concludes that a thorough examination of this reaction might throw a new light upon the proteic bodies. Coagulated albumen, heated with twice its weight of crystalline hydrate of baryta, and a sufficient quantity of water (1 litre per 100 grms. of dry albumen) begins to dissolve. When the temperature reaches the boiling-point, ammonia escapes, and carbonate of baryta is deposited. At the end of some hours the production of ammonia and carbonic acid slackens, and ceases almost entirely. At ordinary pressure, at 100°, the quantity of ammonia set at liberty in 120 hours of

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ebullition, has been found equal to 1·7 grm. per cent of dry albumen. The determination of the weight of carbonate of baryta led to this interesting result, that the ammonia and carbonic acid given off are exactly in the proportions required for urea. If the operation is carried on in an autoclave at 140° and 150° the reaction is more complete, the results being 4·1 ammonia per cent of dry albumen, and 24·0 carbonate of baryta, calculation requiring 23·7. The barytic precipitate contains a little oxalate and sulphite of baryta. From these observations it follows that the molecule of albumen contains the group of urea, and represents a complex ureide. It ought also to contain a group analogous to oxamid. A part of the sulphur of the albumen, that which alkalies do not immediately remove in the form of a sulphide, is contained in the state of a sulphurous derivative, reminding us of the taurine of the bile, which boiling alkalies split up into sulphate and acetate. The comparison is the more permissible, because very sensible quantities of acetic acid are found in the liquid. Returning to the liquid, freed by filtration from the deposit of barytic salts, and from free ammonia by prolonged ebullition, it was found of a yellowish colour. When freed from baryta by treatment first with carbonic, and then with sulphuric acid, and cooled, it yielded successive crops of crystals. The aqueous crystallisations were—Tyrosin, about 5 per cent; very little amido-œnanthylic acid, amido-caproic acid, or leucin in notable quantity; amido-valeric acid, butalanine; amido-butyric acid. Albumen cannot in any case be the sole result of the union of leucin and its homologues. Along with these latter the author has isolated crystalline definite bodies, having less hydrogen.

Action of Electrolytic Oxygen upon Methylic Alcohol.—M. A. Renard.—The gas given off is small in amount, consisting of carbonic oxide, carbonic acid, and a small amount of a gas soluble in water, which appears to be oxide of methyl. On distilling the alcohol after its oxidation, and treating the distillate with chloride of calcium, a liquid is obtained, consisting of formiate of methyl, methylal and acetate of methyl. Methylic aldehyd is not formed.

Flame of Sulphur; and on Divers Lights useful in Photography.—A. Riche and C. Bardy.—The authors have re-examined the bisulphide of carbon and nitric oxide light of Delachanal and Mermet in the hope of finding means to obviate the danger of explosion, either by modifying the manner of operating, or by suppressing the use of sulphide of carbon, and of comparing the various flames which act upon the salts of silver. They recommend as the most efficacious, and as perfectly free from danger, the flame of sulphur burning in a jet of oxygen.

Determination of Atmospheric Ammonia.—Th. Schlœsing.—This paper is not intelligible without the accompanying illustration.

Presence of Copper in the Human Organism.—MM. Bergeron and L. L'Hôte.—The authors hold that copper, derived from various sources, is generally found in the kidneys and liver of human beings irrespective of age, sex, and condition of life. The examination of fourteen corpses and of six fœtus gave in every case affirmative results.

Electro-Chemical Resistance of Aluminium used as the Positive Electrode of a Voltameter.—M. E. Ducretet.—A voltameter with acidulated water received a slip of platinum and a slip of aluminium, placed in communication with the poles of a battery; if the aluminium is the negative electrode, hydrogen is disengaged upon it, and the current has its ordinary intensity. When the direction of the current is reversed, there is no longer decomposition of water, and the intensity of the current becomes very feeble. The surface of the aluminium does not seem affected; it is preserved by a thin layer of alumina. The author applies these results to the construction of a liquid rheotome, permitting the passage of the current only in one direction.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 13, January, 1875.

Scum from Sugar Works, and the Danger of their Presence near the Manufactories.—M. Eug. Perrot.—The scum, after exposure to the air for some time, gives rise to an orange-red vegetation, which has been classed among the algæ. This plant is not merely the result of a phenomenon of fermentation, but is a true ferment, the origin of which coincides with a repulsive odour given off by the heap of refuse. This ferment acts upon saccharine juices in a very remarkable manner, the result being the transformation of the sugar into mannite. It acts merely upon alkaline liquids, a fact the more important, as this is the general case in the extraction of sugar from beet-root. If the juices are acid they resist the ferment. If the juice is taken as it leaves the bone-black filters, containing a mean alkalinity of two to three ten-thousandths of alkali, and if a few fragments of the ferment are added, the liquid exhibits all the signs of fermentation, which is complete in eight to ten days. The resulting matter, evaporated gently over sulphuric acid, then dissolved in alcohol, and evaporated anew, deposits crystals, which present all the physical and chemical characters of mannite.

Revue Universelle des Mines, de la Metallurgie, de, Travaux Publics, des Sciences et des Arts Appliques a l'Industrie, November and December, 1874.

Reform of the Patent Laws.—Dr. Klostermann.—A powerful argument against the party who in the name of "free trade" seek to rob the inventor of his own exclusive creations.

American Legislation on Patents.—J. M. Thacher.

Statistical and Geographical Documents on Mining Industry.—1, Russia; 2, Portugal.

State of Mines in the Island of Sardinia.—M. Sella.—Conclusion.

Account of the Pernot Furnace.—M. Jules Petin.

Les Mondes, Revue Hebdomadaire des Sciences. No. 2, January 14, 1875.

The Abbé Moigno states, on the authority of Dumas, that in consequence of the "materialistic discourses" of Prof. Tyndall, Dr. Du Bois-Reymond, &c., the politicians of Great Britain have been abruptly checked in their resolution to encourage more effectually higher education (!)

Nos. 3 and 4, January 21 and 28, 1875.

These numbers contain no chemical matter.

Reimann's Farber Zeitung, No. 1, 1875.

This number contains a receipt for a dark cinnamon and a dark reddish brown on wool; a black, violet, and brown on knitting-yarns; a light, medium, and dark olive on cotton yarn; a brown on silk; a bismarck, Russian green, brown, and dark olive (reseda) on leather; removal of the fatty gloss from woollen and mixed rags.

Aniline Black.—Hitherto it has been considered impossible to remove or discharge aniline black. G. Witz, however, has shown it to be possible. He treats the aniline black with an acidulated solution of permanganate of potash, when peroxide of manganese is deposited upon the fibre. This is then treated with a solution of oxalic acid, which removes the manganese, and leaves the tissue perfectly white. The solution of permanganate may be thickened with infusorial silica (kieselguhr), and printed upon the tissue, so that a white design can be produced upon an aniline black ground. The peroxide of manganese can also be produced by other methods, *e.g.*, by successive treatment with salts of manganese and caustic soda.

Distinction Between Natural and Artificial Alizarin.—J. Weber proposes the following method to show

whether goods are printed red with extract of madder or with artificial alizarin. If the red in question is steeped in a solution of permanganate of potash, and then passed into an acid, the red produced with extract turns a reddish yellow, whilst that produced with artificial alizarin retains a decided rose colour. The two reds are still better distinguished by successive treatment with bichromate of potash and nitric acid. The red produced with extract is almost entirely discharged, whilst that from artificial alizarin retains a decided rose shade. If the tissue thus treated is boiled for two minutes in soda-lye at 18° B., washed and dipped in hydrochloric acid at 20° B., the red from artificial alizarin becomes light yellow, and that from extract a dirty orange. The experiments may be performed as follows:—The swatches are steeped for two minutes in a solution of 1 grm. permanganate in 200 c.c. of water, washed, plunged into hydrochloric acid at 3° B., washed, passed again into permanganate of potash, washed, and finally passed into solution of oxalic acid at 1° B. If chromate is preferred, the swatches are steeped two or three minutes in a solution of 10 grms. bichromate in 200 grms. water, drained, passed through nitric acid at 5° B., and washed.

Bulletin de la Societe Chimique de Paris, No. 12, December 20, 1874.

Absorption of Gypsum by Bone-Black.—M. F. Anthon.—Bone-black is very difficult to wash to such an extent that the washings no longer precipitate chloride of barium. If over black thus washed there is filtered a saturated solution of sulphate of lime, it is found that the filtrate contains sulphate of ammonium. There is, therefore, a chemical reaction, and not a mere absorption in this case. Black which has absorbed gypsum yields it again to distilled water (*Dingler's Polytechnisches Journal*).

Use of Fluorides in the Manufacture of Glass.—MM. Hagemann and Jörgensen.—In America cryolite is used in making a white milky glass. The proportions are 9 parts of zinc white, 4 of cryolite, and 10 of quartz sand. The glass is very hard, brilliant, and not attacked by acids, even when powdered. This glass gives on analysis—

Oxide of zinc	6·50
Silicic acid	63·40
Alumina	3·67
Soda	5·85
Oxides of iron and manganese	4·40
Cryolite	15·14
	99·96

In the manufacture of bottle-glass is used the fusible slag formed by the residues of cryolite melted with chalk for soda and alumina. This mass contains—

Chloride of calcium	62·01
Carbonate of lime	11·89
Lime	5·62
Carbonate of potash	0·37
Carbonate of soda	3·94
Magnesia	0·93
Silica	3·78
Oxide of iron	5·00
Alumina	5·00
Water	1·45

A bottle-glass, to which 9 per cent of this had been added, contained—

Potash	2·85
Soda	6·99
Lime	15·40
Magnesia	1·08
Alumina	11·00
Oxide of manganese	2·79
Oxide of iron	3·60
Fluorine	1·75
Silica	55·20

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in preserving blood for use as food. Edward Heinson Huch, Brunswick, Germany. May 15, 1874.—No. 1734. This Provisional Specification describes mixing lime with blood, and allowing it to settle, and then drawing off the clear liquid, and drying it with or without farinaceous matters.

Improvements in the manufacture and refining of sugar. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Henri Armand Joseph Manoury, Paris.) May 15, 1874.—No. 1736. This invention relates to the treatment of molasses, syrups, and other similar saccharine products obtained in the manufacture and refining of sugar; and consists in first adding to such molasses, syrups, or other similar saccharine products an alkaline carbonate, such, for example, as carbonate of soda or of carbonate of potash, for the purpose of rendering the organic and other compounds more soluble in dilute alcohol than they are when they exist in combination with lime.

Improvements in obtaining sulphate of soda or of potash, hydrochloric acid, and chlorine. Emil König and James Henderson, manufacturing chemists, Irvine, Ayr, North Britain. May 16, 1874.—No. 1742. This invention relates to improvements and modifications in processes of the kind described in the Specifications of Letters Patent, Nos. 853, 1305, of 1871; and No. 571 of 1872; granted to Emil Konigs, one of the present applicants; and No. 1642 of 1871, granted to both the present applicants.

A new means to be employed for preserving every kind of animal and vegetable matter. Charles Adalbert Hermann Lindemann, M.D., of Manchester, Lancaster. May 18, 1874.—No. 1753. I claim the discovery of the antiseptic property of boric acid and its compounds, which are all powerful in protecting every kind of organic matter against decay, as well in the living as in the dead state. Consequently I make use thereof for the following purposes:—(1) Preserving fresh meat, blood, and its compounds, like albumen and fibrin; (2) embalming corpses; (3) protecting textile tissues against mildew; (4) curing and preventing contagious and miasmatic diseases.

Improvements in the preparation and application of certain materials for deodorising sewage, night-soil, and like matters, and in the manufacture of artificial manures. John Howard Kidd, Wrexham, Denbigh. May 19, 1874.—No. 1764. The invention consists in applying as a deodoriser carbonaceous or coal shales or coal washings, which materials are heated or carbonised in a suitable furnace, such as retort furnaces, and is then pulverised if desired. When thus prepared it is mixed with the sewage or night-soil, or other like matters requiring to be deodorised. In treating sewage, the solid matter is allowed to settle in tanks, then the surplus water is drained away, and salt or lime is added, and then sufficient mineral carbon or material obtained from carbonaceous shales or coal washings as above explained is added, and mixed with the sewer sediment to cause it to dry readily. The material thus obtained is further and greatly enriched as a fertiliser by the addition and mixture of bone-dust, nitrate of soda, sulphate of ammonia, and other like matters.

MEETINGS FOR THE WEEK.

Saturday, Feb. 27th.—Physical, 3. Mr. T. Wills, F.C.S., "On a Mode of Exhibiting to a Large Audience the Spectrum of Sodium." G. C. Foster, F.R.S., and O. J. Lodge, "On the Lines of Flow and Equipotential Lines in a Uniformly Conducting Sheet."

Monday, March 1st.—Medical, 8.
—— London Institution, 5.
—— Society of Arts, 8. (Cantor Lectures.) Rev. Arthur Rigg, M.A., "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft."
—— Royal Institution, 2. General Monthly Meeting.

Tuesday, 2nd.—Civil Engineers, 8.
—— Zoological, 8·30.
—— Royal Institution, 3. Alfred H. Garrod, Esq., "On Animal Locomotion."

Wednesday, 3rd.—Microscopical, 8.
—— Pharmaceutical, 8.
—— Society of Arts, 8. Captain Bedford Pim's reply to the Discussion on his paper "On the Mercantile Marine of Great Britain.

Thursday, 4th.—Royal, 8.30.
—— Royal Institution, 3. Professor Tyndall, "On Subjects Connected with Electricity."
—— Royal Society Club, 6.30.
—— London Institution. 7.
—— Chemical, 8. P. Braham and J. W. Gatehouse, "On the Dissociation of Nitric Acid." O. Thudicum, "Chemical Constitution of the Brain." G. C. Kingzett, "Calcic Hypochlorite from Bleaching-Powder." W. N. Hartley, "On a Simple Method of Determining Iron."

Friday, 5th.—Royal Institution, 8. Weekly Evening Meeting. Lord Rayleigh, "On the Dissipation of Energy," 9.
—— Geologists' Association, 8.

Saturday, 6th.—Royal Institution, 3. Prof. W. K. Clifford, "On the General Features of the History of Science."

THE CHEMICAL NEWS.

Vol. XXXI. No. 797.

LECTURES ON THE MORPHOLOGY OF CRYSTALS

AT THE

CHEMICAL SOCIETY.

By NEVIL STORY MASKELYNE, M.A., F.R.S., &c.

(Continued from page 64).

Lecture VIII.

In resuming his lectures on crystallographic morphology after the Christmas vacation, Mr. Maskelyne took in hand to discuss the various crystallographic systems, as representing the kinds of symmetry possible in crystals.

Fig. 9.

The first of these systems to be considered was that which presented no plane of symmetry, symmetry to a centre being its only restriction in this regard. In this, the anorthic system, the faces will obey the zone laws already discussed; and, since the crystal is centro-symmetrical, each plane will be parallel to another plane belonging to its normal, and differing from it in symbol by the signs of the indices being opposite in character. These conditions involve no requirement not already recognised as resulting from the crystallographic law, and consequently all the five axial elements are free. The axial system may be expressed by the symbol—

$$\xi, \eta, \zeta; \; a:b:c.$$

Such an axial system may be yielded by any four planes of the crystal, though important ones are generally chosen, and a position can always be found such that the angles of the axes Y Z and Z X are each greater than 90° in the positive octant, the angle of the XY axis being consequently either greater or less than 90°. The *form* in such a system as this will consist of but a pair of faces.

Next in order as we rise in the degree of symmetry presented by a crystal, we come to the clinorhombic system, the crystals belonging to which are symmetrical to a single plane, and at the same time to their centre. If we consider any of the zones on such a crystal to which the plane of symmetry belongs, it is not difficult to see that such a zone will be ortho-symmetrically divided by the plane of symmetry, and by a plane perpendicular to it. It will further be evident that all the faces of a *form* will belong to such a zone, and that they will therefore be four in number; the only exceptions will be those of the plane of symmetry itself and the faces perpendicular to it, for which cases the faces of a form are only two in number.

An axial system for a crystal of this kind is obtained by making the plane of symmetry one of the axial planes, namely, the plane Z X, and taking for the other two two of the planes perpendicular to the plane of symmetry. The positive angle Z X or η is taken greater than 90°.

It results, from what has been said of this system, that all the forms of it have the character of rhombic prisms, with the exception of the planes $(h\,o\,l)$ that occur only in pairs in the zone $[100, 00\bar{1}]$, and of the pair of planes (010) $(0\bar{1}0)$ which are parallel to the plane of symmetry. The axial system under this type of symmetry will be represented by the expression—

$$\xi = \zeta = 90, \; \eta > 90 \; ; \; 1, \frac{b}{a}, \frac{c}{a},$$

where two of the five elements become fixed, in order that the crystal may fulfil the conditions entailed by one of its faces becoming a plane of symmetry.

The distribution of the poles of a form in the clinorhombic crystal is represented in the projection (Fig. 9): the eyelets representing the poles on the nether, the dots those on the upper hemisphere of projection. The poles of the forms $(1\,1\,1)$, $(\bar{1}\,1\,1)$, $(h\,k\,l)$, $(h\,o\,l)$, $(1\,0\,1)$, $(1\,1\,0)$, and $(0\,1\,1)$ are projected in the figure.

Lecture IX.

Before passing to the consideration of crystals symmetrical to more than one plane, Mr. Maskelyne took in hand the sort of distribution that the features of a crystal must present in a general case where there are two planes of symmetry. In such a case, viewing the poles of a crystal form as circumjacent to one plane of symmetry, it is plain that the presence of a second plane of symmetry will necessitate a distribution of the poles of a form, and of the other features of the crystal, in a symmetrical relation with regard to itself, and that at the same time each plane of symmetry and each mode of grouping of the features of the crystal will be repeated over the other plane of symmetry.

Planes of symmetry being thus mutually repetitative will form a zone of planes of one of the kinds already considered, where three or more of the angles included by consecutive tautozonal planes are equal, and it has been seen that such angles can only have the crystallometric values 90°, 45°, 60°, 30°. Therefore, for a crystal to be symmetrical to two or to more planes lying in the same zone, these planes of symmetry can only have mutual inclinations that are crystallometric, and of such there can, therefore, only be four kinds. The first of these to be considered will be that where the two planes intersect at a right angle; and we may approach this case from another point of view.

Thus, if we suppose two of the poles lying on the great circle of symmetry in a clinorhombic crystal to occur at a quadrant's distance from each other, the two planes corresponding to these poles become potentially planes of symmetry, inasmuch as they satisfy the necessary conditions

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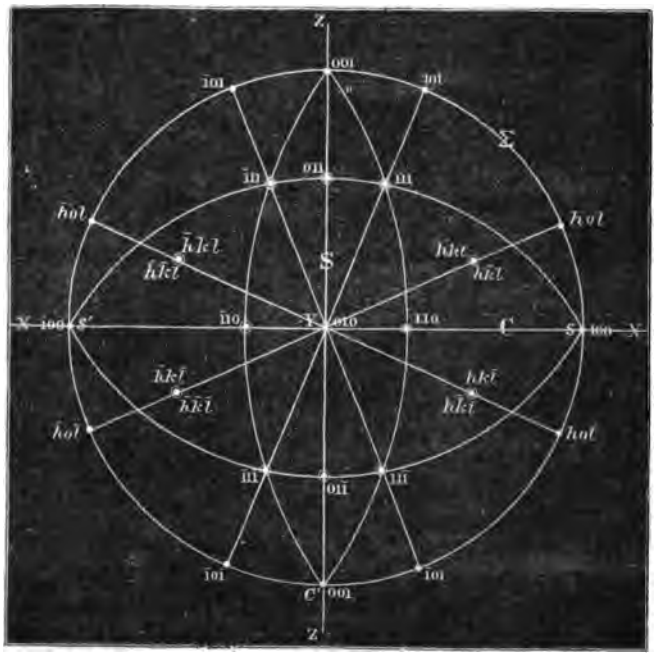
for being symmetrical, and are inclined to each other at 90°; and it is evident that, if any one of the planes of the system perpendicular to the first plane of symmetry is a plane of symmetry to the system, then also must a plane perpendicular to both these planes be potentially a plane of symmetry. Whence we pass at once, from the case of a crystal symmetrical to a single plane of symmetry, to a case in which the crystal is symmetrical to three of its planes which are perpendicular to each other; that it shall be so therefore involves only one condition beyond those that have to be fulfilled in the clinorhombic system.

Indicating the three perpendicular planes of symmetry by the letters S, Σ, and C, which we shall call the proto-, the deutero-, and the trito-systematic planes, we may proceed to discuss the character of a form belonging to such a system.

Taking these three systematic planes for axial planes, the zone axis of each pair (which is also the normal to the third plane) becomes a crystallographic axis, while the axial octants are commensurate with those formed by the three planes. Each octant will thus contain one pole of a form *h k l*, so that such a general form will present eight faces; and these faces will be scalene triangles.

The distribution of the poles of a form (*h k l*), and of the forms (1 1 0), (1 0 1), (0 1 1), and (1 1 1), as also of the two-faced forms (1 0 0), (0 1 0), (0 0 1), is exhibited in the projection in Fig. 10.

Fig. 10.



The axial system will be represented by the expression—

$$\xi = \eta = \zeta = 90 \quad \frac{a}{b}, 1, \frac{c}{b},$$

the two elements involved in the three parameters being unfettered. That these three parameters must all have different values, or at least values that can only be transiently equal at some special temperature, is seen in this: that, supposing a pole to be at a point bisecting one of the quadrants between the axes on, for instance, a great circle, C, a similar pole must occur on that great circle at a quadrant's distance from the assumed pole, and the faces to which these poles belong will satisfy the conditions of planes of symmetry, and will be inclined on the plane S and Σ at the crystallometric angle 45°, an angle therefore, compatible with their being planes of symmetry.

In observing, of the parameters in the orthorhombic system which we have just considered, that any one of the parametral ratios can represent equality at only one temperature, it becomes necessary to consider for a moment what is the effect of change of temperature in altering the morphological character of a crystal. Thus, with increase of temperature the crystal expands, but in the same degree only along directions that are morphologically similar; and, as a consequence of this, the angular inclinations of the faces of a crystal will also change.

Now, since the symbol for a plane involves two sets of ratios, those, namely, of the parameters of the crystal and those of the indices of the planes, but as, moreover, a symbol for a zone is directly deducible from the indices of its planes, it is clear that, if those indices have to be changed to represent the result of a change of temperature, the character of the zones, and so of the symmetry of the crystal, would undergo change. This, however, cannot be, for the indices, being rational numbers, can only change *per saltum*, whereas the expansions or contractions, and the angular changes accompanying them, are continuous. Consequently it is the parameters, and not the indices, that change, and the zones, and with them the symmetry of the crystal, retain permanently their original characters in regard to symmetry; and it will further follow that the angles at which planes of symmetry are inclined to one another are permanent at all temperatures.

The next point on which Professor Maskelyne dwelt, before considering in detail crystals of a more complex symmetry, was the character of the spherical triangles formed by the intersections of the great circles lying in the planes of symmetry. Since, where two planes of symmetry exist in a crystal, the plane of their zone circle fulfils the conditions for being potentially a plane of symmetry, these three planes of symmetry will intersect with the surface of the sphere in three great circles to the triangle formed to which Mr. Maskelyne gave the name of the *systematic triangle*. Each crystallographic system, where there is more than one plane of symmetry, will thus be characterised by a systematic triangle of its own, and the sphere will become partitioned into a series of such spherical triangles resulting from their mutual repetition, alternate triangles being directly congruent, whereas adjacent triangles are not so.

The systematic triangle of the orthorhombic system will thus have its sides quadrants and its angles right angles, and would be represented by the expression—

$$S = \Sigma = C = \frac{\pi}{2}$$
$$s = \sigma = c = 90°.$$

The different letters which correspond to the different planes of symmetry indicating that these planes of symmetry are not *conformable* with its other; that is to say, that the features of the crystal are distributed in a different manner in respect to them severally.

The small letters indicate the angles, while the large ones represent the signs of the systematic triangle. It is evident that we may have various kinds of crystalline forms belonging to each crystal; varying, that is to say, according as their poles are situated either within a systematic triangle, or upon one or other of its three sides, or, finally, at the points at which those sides meet, namely, in the angles of the triangle and the symmetry presented by each such form will be of a different kind.

In the orthorhombic system, the general form, *h k l*, representing the scalene octahedron, has its poles within

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the triangles, and the symbol only varies in the signs, not in the relative order of its indices. The rhombic prism $h\,k\,o$ has its poles on the sides *C*.

The protodome $\{o\,k\,l\}$ has its poles on the arcs, *S*, of the systematic triangle, and its zone-axis coincides with the normal of the proto-systematic plane, the axis X.

The deuterodome $\{h\,o\,l\}$ has its poles on the arcs Σ, and its zone-axis, to which the edges are parallel, is the axis Y.

(To be continued).

SECOND NOTE ON SULPHOVINIC ACID.

By Dr. T. L. PHIPSON.

According to the promise contained in my first note (Chemical News, vol. xxx., p. 221), the mixture of sulphuric acid and alcohol was submitted to the heat of a water-bath for three entire days, at the end of which time it was cooled, dropped very slowly into twenty times its bulk of cold water, and carefully saturated with carbonate of lime. The result was no better than with the acid prepared in the course of a few hours, and the quantity of sulphate of lime formed quite as great as before. It is, therefore, not possible to obtain a larger amount of product by this prolonged action of a temperature calculated to drive off the water separated from the alcohol.

The difficulty of obtaining pure sulphovinic acid, the great tendency of this acid and its salts to decompose and form bisulphates with production of alcohol, will, in all probability, preclude for ever their use in pharmacy. The sulphovinates of lime, potash, and baryta that I prepared many months ago in crystals, have hitherto kept without decomposition in simply corked bottles, but it is very doubtful that they would keep long in solution.

ON THE MANUFACTURE OF CAUSTIC SODA.*

By JOHN MORRISON, F.C.S.

(Continued from page 88.)

I have not very much to say about the black-ash or ball furnaces proper; for, excepting that they are larger, and that their sides, instead of being metal plated, are simply secured by a number of horizontal strips of flat iron (say, 4½ inches × ¼ inch), they are pretty similar to those used on the Tyne. The fire-places are, however, peculiar. The fuel is supplied, not at the side, but at the end just under the arch, an open space (extending the full length of the furnace) being left for the purpose. The arch is not dome-shaped, but—highest at the fire end—is regularly depressed towards the other. Across the fire end of the furnace is a metal plate 2 feet in depth, cased up with 9-inch brickwork, and having a number of perforations 3 inches in diameter, corresponding with a similar number of pigeon-holes left in the casing. These holes are for the admission of air to the burning fuel. The perforated plate rests on the outer edge of an ordinary dead plate, under which are the fire-bars as usual. The fire-place is the full width of the furnace-bed, but to prevent waste of coal in clinkering (by facilitating the "damping" of the fire), a 9-inch mid-wall is run up the centre of the grate, terminating about 9 inches above the bars. The whole arrangement is simply a modified "cave" fire-place. The perforations raise the area of the most intense combustion to nearly, or even a little over, the top of the bridge, and cause a sharp, steady, and very effective flame. Were the perforations closed, the men would be unable to get their work out properly, as, though there might be plenty of draught, there would, as they express it, be no "cut;" and then there is the other advantage of diminished wear and tear of fire-bars, which are kept much cooler than they could possibly be were all the air admitted between them.

Perhaps I had better not omit to add that "air courses" are the exception rather than the rule in Lancashire furnaces, and that a well-built 18-inch bridge lasts six months or longer, if care be taken that the fire-bars do not come below the level of the working "bed;" and I may as well also add that "beds" are very rarely taken out, the usual plan being, about once a month, to put on a patch of broken bricks and sand, fluxed in with a little salt-cake, the business, which does not necessitate the stoppage of the furnace, being done by the men themselves, in the interval between their shifts.

The tanks or vats, with their settlers, are, excepting in their slightly modified fittings, almost identical with those in use here, so that I may without delay proceed to describe the specialities of the caustic plant proper.

There are three stages in this manufacture—causticising (including filtration of mud), concentrating, and finishing.

The causticiser, or operation pan, may be of any convenient shape, but is usually a vessel 26 feet by 6 feet, and 6 feet 6 inches deep, the bottom being circled. It is provided with an agitator (driven by a small bracket engine bolted to the end of the pan), one or more steam-pipes for heating the charge, a sludge-valve for running off the mud, and, if necessary, a drop syphon for removing the clear liquor.

Sometimes, when economy in plant is an object, mechanical agitation is dispensed with, and the cheaper arrangement of injections or "blowers" substituted. These, by forcing through the liquor a mixture of air and steam, serve the double purpose of agitating and heating, and, in addition, assist in the oxidation of the sulphides.

The filter is usually of wrought-iron. Frequently an old boiler, cut in halves longitudinally, serves the purpose. But, if specially made, it is generally about 20 feet by 10 feet, and four feet deep. On the bottom are placed, in an open manner, bricks on edge, say, about 2 inches apart, but along the centre a clear channel is reserved, which in its turn is loosely covered with bricks or slabs; on the top of this arrangement is a layer of coke or limestone (preferably the former) 8 or 9 inches in depth, then a second layer of smaller pieces, and third still smaller, lastly a covering of clean coarse sand or small coal, on which cast- or wrought-iron grids are laid to afford a convenient shovelling bottom. A barrow or two of clean riddled cinders from one of the furnaces, or a similar quantity of small coal scattered over the grids, then renders the filter—in which there still remains 18 to 24 inches in depth of clear space available for lime mud ready for use; but communicating with the sough or channel just described, in the bottom of the filter, is a 2 or 3-inch pipe, connected with a small boiler or air-tight tank of, say, 150 or 200 cubic feet capacity, erected preferably above the level of the operation pan, and which is in its turn in connection with a vacuum pump. The top of this boiler is provided with an air-cock, and to the bottom a run-off tap is attached; the former for the admission of air, when the liquor is being removed by means of the latter. And when a water-gauge has been affixed to the end of the boiler, the filtering apparatus may be said to be thoroughly equipped. The second stage includes the evaporation of the liquors.

Attached to each black-ash furnace, in place of the ordinary salting down or black salt pan, are two cast-iron boat-pans, placed end to end, to form a prolonged continuation of the furnace. The term "boat," it is perhaps scarcely necessary to say, only applies to the dished sides, for the ends are quite upright, and the form of the top being rectangular, with slightly rounded corners. The usual dimensions of these pans are 12 feet by 8 feet, measured on the top, with a depth of 3 feet along the central or deepest portion. The pan furthest from the furnace is placed about 6 inches higher than its neighbour, and the

* A Paper read before the Newcastle-upon-Tyne, Chemical Society.

bottom of the latter corresponds in height with the soffit of the black-ash furnace arch. One continuous 14-inch mid-wall, on which the bottom of the pans rest, sustains the major portion of the weight of the latter, while a front and back 14-inch wall (which are simply extensions of the furnace sides), built up to the flanged tops, firmly supports or stays their two sides. In other words, the pans are sustained by three parallel longitudinal brick walls, and across the two flues or passages which the latter form, are built up to within 8 inches of the pan sides, and carrying their sweep three or four fire bridges, for the purpose of keeping the flame well up to the metal, and the hollow spaces intervening between the bridges are filled up to within a foot or so of the pan with brickbats or clinkers, with a similar object. The flame, on emerging from the black-ash furnace, passes over these bridges, traversing the full length of the two pans, previously to passing into the drop at the far end of the back one, which is in communication with the main flue. Those just described are termed the "weak" pans, but to them the "strong" pans are precisely similar, excepting that, instead of being subjected to the action of "waste" heat merely, they are self-fired. There are two arched fire-places attached to the front, or working pan, of each pair, built side by side against its outer end. They are each about 4 feet 6 inches by 2 feet 3 inches, one being opposite each flue; that is to say, one is built on each side the central supporting wall, which extends outwards for the purpose. The products of combustion from each fire pass along their own side, till, on arriving at the end of the back pan, they unite and pass down one common drop in connection with the chimney.

The pots in which the third stage is completed are constructed to hold 10 tons of finished caustic soda, being 9 feet in diameter and 5 feet 6 inches in depth. They are set in innumerable ways (every manager having his own pet fashion), with the common object of dividing the heat, so that the "boil" may take place equally all round; for if the flame impinge too much on one side, that portion will wear out very rapidly. The great aim, in short, is to prevent the pots becoming thin and wearing into holes at one particular spot. They do not, however, usually die of genuine old age, but become useless most frequently by eakage caused by the formation of a hole or open crack generally one or two feet from the bottom. Neither is the wear of a smooth character, but chiefly exhibits itself in blotches, or pock-marks of greater or less depth, and from ¼ to ½ an inch in diameter. The side of the pot against which the fire is built is almost invariably protected from the direct action of the flame by means of a guard or shield of brickwork, against which the flame splits into two portions, which between them encircle the pot before uniting again to pass into the flue. Generally the pots rest on a metal plate, and are stayed in an upright position with brickwork; but the chief support is secured by the circular curtain wall—forming the side flues—into which three lugs cast equidistantly round the pot, about a foot from the top, project. The metal plate just alluded to facilitates the occasional turning of the pot, which is advisable to prevent localisation of the wear.

In the best constructed caustic soda works the pots are all within range of an overhead traveller, which very much simplifies any alteration or removal. Without this appendage, the business is a comparatively troublesome one, for the pots, weighing about 6½ tons, are rather awkwardly shaped for convenient handling, and any pleasure there might otherwise be in the job is seriously marred if, as is usual, a neighbouring pot is in process of being nitred, for at such times the work of turning or removal is particularly disagreeable; and if the results are less to be feared, the temporary sensations are quite as decided as the process of stinging by an indefinite number of pretty lively wasps.

Occasionally, caustic pots are heated by gas generated in an ordinary producer, but experience has shown this method to be anything but economical in fuel.

(To be continued.)

SOCIETY OF PUBLIC ANALYSTS.

"SALE OF FOOD AND DRUGS ACT, 1875."

Since we had occasion to refer to this embryo Bill last week, it has been interesting to notice with what a chorus of disapprobation it has been received by the press, and how the fatal objections, which we were the first to point out, have been generally appreciated and endorsed.

The *Times*, in a leading article on the 1st inst., commented upon a letter which the Secretaries of this Society had felt it their duty to address to that Journal, and said—"All persons, and especially all poor and comparatively illiterate persons, should have reasonable security for obtaining the chief necessaries of life in a state of such purity that they may really possess the nutritive or other properties with which they are credited by the purchasers."

In reference to the exception under Section 6, which renders the "usage of trade" an excuse for adulteration, and to which exception we have already most emphatically objected, the *Times* says—"It would be a prodigious gain if the influence of law could bring the adulteration of necessaries to be regarded no longer as an 'usage of trade,' but as a disgraceful offence; and there can be little doubt that such a change in the commercial way of looking at things would speedily tend to diminish adulteration generally."

In meeting another objectionable point in the Bill, the *Times* well remarks—"If the vendor pleaded mere ignorance, his plea ought not to save him; and if he pleaded that he had himself been deceived by the person from whom he purchased, his remedy should be in bringing that person before the Court, and having him punished. . . . . The moderate penalty, however, which would destroy the dishonest profit of the retail adulterator would be a comparatively small tax on the dishonest profit of the wholesale dealer, and to meet this difficulty it might be provided that the amount of the fines should bear some proportion to the quantity of adulterated goods which had been sold." In concluding this article, the same Journal observes—"The Secretaries of the Society of Public Analysts assure us that the business of food analysis is daily becoming better understood; but, notwithstanding this, it would be judicious that the number of analysts should, at first, be somewhat limited, and that their remuneration should be such as to place them in a position of independence."

The *Lancet* has published an able and exhaustive article echoing and amplifying our objections to the Act. We have not space for any quotations, but we will give the closing one, which involves the conclusion of the whole matter:—"One would think that it (the Bill) had been drawn up by a conclave of adulterating manufacturers, who, while professing the desire to afford the public some protection against adulteration, yet contrived that the measure should cover nearly every form and species of adulteration which the ingenuity of man has hitherto succeeded in devising."

In reference to the exception which we took to the definition of the word "food," in Section 3 of the new Bill, we have recently had occasion to peruse "An Act to impose License Duties on Compounders of Spirit, &c.; and to prevent the Adulteration of Food, Drink, and Drugs," passed by the Parliament of the Dominion of Canada, in May last year. From this Act we quote the definiton of the words *food* and *drink*, and we think that, for clearness and comprehensiveness, the Imperial might well take a lesson from the Colonial Legislature:—

Food "means and includes every article used as food in the state in which it is offered for sale, or that is used in the preparation of food by admixture therewith either before, during, or after cooking."

Drink "means and includes any liquid used as a beverage, and any article used in or for the preparation or partial preparation of any beverage."

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FORM OF CERTIFICATE.

To * and

To all to whom it may concern.

I, the undersigned, Public Analyst for the , do hereby certify that I received on the day of , 18 , from† , a sample of for analysis, which then weighed , and have analysed the same, and declare the result of my analysis to be as follows :—

The said sample contained the parts as under.

Observations.‡

I return the residue of the sample not consumed in the analysis herewith.

As witness my hand this day of , 18 .

A. B.,
at .

* Here insert the name of the person submitting the article for analysis.

† Here insert the name of the person delivering the sample.

‡ Here the analyst may insert, at his discretion, his opinion as to whether the mixture (if any) was for the purpose of rendering the article portable or palatable, or of preserving it, or of improving the appearance, or was unavoidable, and may state whether in excess of what is ordinary, or otherwise, and whether the ingredients or materials mixed are or are not injurious to health.

We will now endeavour, very briefly, to draw attention to one or two flaws in the new Act, which have, we think, up to now either partially or wholly escaped notice :—

The first "exception," under Section 6, would—under pretence of rendering an article "portable, or of preserving it,"—admit of the addition of sulphuric acid to vinegar, and of salt to milk.

The second "exception" would—under pretence of rendering an article "palatable, or of improving its appearance"—allow of the adulteration of coffee with chicory, bread with alum, mustard with flour, &c.

Section 8, which may be described as the "labelling one, might well be incorporated with Section 6 as an "exception," and it is indispensable that the word "legibly" should be inserted in the proper place, as we have heard of labels where the type was so exceedingly ornamental and minute as to convey no real warning of the "mixture" to the purchaser unprovided with a magnifying glass.

Section 7 provides for the punishment of a person selling an adulterated article "if the matter mixed be more than is ordinarily required." Will the promoters of the Bill kindly inform us of any fixed standard of the quantity of an adulterant "ordinarily required"?

In Section 19, which refers to the Analysts' Quarterly Reports, it would be convenient to add a clause permitting the addition of any remarks—in reference to any of the samples analysed—which the Analyst might consider it desirable to make.

In Section 25 we have already pointed out that—while the retailer could not be punished if he could produce a "warranty" from the wholesale dealer—no provision is made for the punishment of the wholesale dealer if such a "warranty" is found to be false; but besides this, it is clear that if—with any modifications—this "warranty" business is to be persevered in, some specific form of "warranty" should be prescribed by the Act, and some means provided for verifying the connection between a given warranty and a given sample.

The Bill contains, as a Schedule, a proposed form of certificate, which document we reproduce above, with the single remark that as a specimen of involved and impracticable absurdity it really is ingenious.

A less ambitious and very much simpler form of certificate will be submitted to the Local Government Board, and, if approved, we may print it next week.

The Bill was committed *pro forma* last evening, with a view to its being reprinted with, of course, the alterations the Government are prepared to accept, but what shape it may bear when next we have to speak of it it would be hazardous to predict. We trust, however, that if it be not entirely re-cast,—which would be, perhaps, the best plan,—at any rate the obnoxious clauses to which such general attention has been called will be expunged. It is, in any case, satisfactory to know that—before it becomes Law, it must pass the ordeal of that Upper Chamber where "trade" interests are less likely to be considered than the good of the community at large.

ON THE
POISONOUS INGREDIENTS AND MIXTURE CLAUSES OF THE "SALE OF FOOD AND DRUGS ACT."

Two objects are aimed at in the Adulteration Acts,—viz., the prohibition of poisoning, and the prohibition of selling articles of food or drink under wrong names.

In order to prohibit poisoning the old Adulteration Acts, as well as the Bill designed to supersede them, enact that the admixture of anything poisonous with an article of food shall entail heavy penalties. Now, on examination, it appears that this phraseology is not happy, and, instead of the offence being the admixture of a poisonous material with an article of food, it ought to be defined to be *the rendering an article of food poisonous.* The two things are by no means identical, as a few examples will make manifest. Thus, although the substance which imparts the almond flavour is poisonous *per se*, and although the confectioner who flavours articles of food with the almond flavour becomes liable to the penalty of £50 under the Act, yet it would be most monstrous to fine him, since articles of food are not necessarily rendered poisonous by almond flavouring.

Sulphuric acid *per se* is highly poisonous, and yet vinegar with a little sulphuric acid in it is not poisonous at all. The essential oil of mustard *per se* is poisonous, and yet a minute quantity of it in food is not poisonous but wholesome. A proportion of sulphate of copper which would be poisonous or harmful in bread (which is eaten largely), would not necessarily be poisonous in pickles which are eaten but sparingly; and in short it is unavoidably, right or proper, in many instances, to "knowingly mix an article of food with ingredients of a nature injurious to health," and the legislature would only stultify itself if it were to enact the contrary.

In the Bill at present before Parliament, it will be observed that not only is the mixing of articles of food with poisonous or harmful ingredients prohibited, but the prohibition extends to drugs; and here the consideration will present itself that, since many drugs are poisonous, there would be difficulties in the way of an enactment against the rendering drugs poisonous; and much might be said in favour of excluding drugs altogether from the operation of the New Adulteration Act, and of dealing with them separately in a special Act of Parliament.

Touching the second object of the Acts on Adulteration, viz., the prohibition of the sale of articles of food under wrong designations, it may, perhaps, be useful to show that nothing more than that is really contemplated in those parts of the Bill relating to non-poisonous admixtures. This will indeed be plain from Section 8, which permits a vendor to vend any admixture of articles of food with any non-poisonous substances whatsoever, and in any proportions, provided only that what is done be fairly indicated by the label accompanying the articles. It is not in contemplation to stop the sale of skimmed milk, but to prevent skimmed milk being sold as unskimmed milk. It is not meant to prohibit the sale of mixtures of coffee with chicory, but to prevent such mixtures being sold as pure coffee. Neither would it be wise to prevent the baker from making bread of such flour as requires a trace of alum to render it available for that purpose,

provided only that he would offer it for sale as alumed, if, having made that confession, he could find customers for it.

If, then, the Bill only contemplates putting a stop to deception, the question will naturally arise as to the possibility of much simpler provisions than those at present standing in the Bill. Why should not the section run, "No person shall sell any article of food under a designation which does not fairly indicate what it is."

It is true that such an enactment would throw upon those who have to work the Act the burden of defining what is meant by certain names, and what is a fair description; but this burden they have already, and must continue to bear under any conceivable Adulteration Act.

ORDINARY MEETING,

February 5th, 1875.

Dr. Redwood in the Chair.

The third paper read was by Thomas Stevenson, M.D.:—

THE DECOMPOSITIONS OF MILK,

WITH ESPECIAL REFERENCE TO ITS ANALYSIS WHEN IN A DECOMPOSED STATE.

The analysis of milk which has been kept until natural decomposition has set in, or in some cases advanced to a considerable extent, is an operation which the analyst is occasionally called upon to perform. He may also be required to state the extent to which a second analysis of a milk made at a date remote from the day on which the milk was drawn from the cow, may be expected to differ from an analysis made whilst the secretion was still fresh and undecomposed, and how far a second analysis is vitiated by the changes which milk is liable to undergo when kept. It is also important to be able to obviate, if possible, the difficulties entailed in the analysis of milk by the natural changes which the fluid undergoes when kept. Prior to experience it might, perhaps, be expected that when a milk has become decomposed, its analysis, so as to obtain a satisfactory result, is no longer possible. This, however, is not necessarily the case. At all events such an analysis may very frequently be made, as will enable the analyst to state whether a milk is skimmed or watered, and to ascertain within narrow limits the original composition of the milk, though minute accuracy is seldom possible in a second analysis made when milk is decomposed. In order to be able to overcome the difficulties of the analytical problem to which I have referred, it is requisite that the analyst should be familiar with the changes which milk undergoes when kept. For our purpose we may regard milk as an aqueous solution of milk-sugar, casein, and other albumenoids and mineral matters, holding in suspension butter-fat. The more minute constituents of milk, such as urea, are present in too small quantities to influence materially the results of analysis. The first and most obvious change which milk undergoes is, that it undergoes the lactic fermentation, its milk-sugar becoming converted into lactic acid. This change is not accompanied by any sensible alteration in weight; the elementary constituents of the milk-sugar re-arrange themselves in the same proportions to form lactic acid. No perceptible amount of gas is evolved during the lactic fermentation. The lactic acid formed exercises, however, a very important influence upon the casein, depriving this of alkali, and rendering it insoluble. Probably, also, changes are simultaneously wrought in the arrangement of the mineral constituents of the milk, though, as to these, our knowledge is very imperfect. Although the lactic fermentation is usually stated to be very simple, the change of milk sugars into lactic acid is never in reality so simple; for in all cases there appears to be the formation of a small quantity of ethylic alcohol. Should a milk have simply undergone the lactic fermentation, the analysis of the sample in its decomposed state will, I find, present the following anomalies: (1.) The amount of cream by volume cannot be ascertained. (2.) The specific gravity of the sample will not accord with the original specific gravity of the sample; not only may the change brought about in the casein by acidification alter the density of the fluid, but also the solution of lactic acid produced will have a density different from that of a solution of milk-sugar. (3.) The total solids per cent will not be materially influenced by the lactic fermentation. It is true that the solids yielded by drying a soured milk are usually a little less than those found in the same milk when fresh, but the difference will not be great. The loss is due first to the evaporation of a trace of alcohol; but, secondly, and chiefly, to the decomposition which occurs on drying a sour milk at 100° C., as is shown by the dark brown colour of the dried milk-solids. Concentrated lactic acid chars organic bodies at a temperature of 100° C. (4.) The ash will be a little lower than that of the fresh milk, and the chlorides will be diminished. It is impossible to evaporate, dry, and incinerate a mixed solution of lactic acid and an alkaline chloride without loss of hydrochloric acid. Indeed, it is well known that to obtain all the chlorine in milk it is necessary to ignite with an excess of a base, such as baryta. (5.) If the fat be estimated by exhaustion with ether, the percentage of fat will be too high, since some lactic acid will be dissolved by the ether. Only a portion of the lactic acid formed in the milk will pass into the ethereal solution; some of it will remain combined with the inorganic bases of the milk. Nevertheless, those difficulties may be overcome, provided that the decomposition of the milk has not advanced beyond the stage of lactic fermentation, and that no gas has been evolved. The acidity of the milk may be determined by titration, and the requisite proportion of soda added to a weighed quantity of the sample, which is then analysed in the ordinary manner. Or, a weighed quantity of freshly ignited sodium carbonate is added to a weighed portion of the sample, so that the milk is rendered just neutral to litmus-paper, and the analysis is then conducted as usual. In calculating the results the necessary corrections must be made; first, for the loss of hydrogen on neutralising the acid ($C_3H_6O_3 + NaHO = C_3H_5NaO_3 + H_2O$; or $2C_3H_6O_3 + Na_2CO_3 = 2C_3H_6NaO_3 + H_2O + CO_2$); and, secondly, for the sodium carbonate introduced into the milk-ash. The results by either method are excellent, and there is no solution of lactic acid in ether. Milk, when kept for long periods, especially in partially filled vessels, does not stop at the formation of lactic acid; but the lactic is apt to undergo an irregular butyric fermentation, with the consequent formation of butyric acid. Now this kind of fermentation is accompanied by the evolution of a mixture of hydrogen and carbonic dioxide gases; and the theoretical loss during the conversion of lactic into butyric acid amounts to rather more than one-half of the weight of the lactic acid. But the butyric fermentation is also accompanied by the formation of a small quantity of butylic alcohol, and probably of other bodies also. Hence the equation for the butyric fermentation—

$$2C_3H_6O_3 = 2CO_2 + 2H_2 + C_4H_8O_2$$

is not strictly accurate. Probably the casein and butter-fat are simultaneously altered. The milk acquires a cheesy odour. In consequence of the acid state of the fluid, the fermentation is irregular. A milk which has undergone butyric fermentation is hence almost beyond the reach of an analysis directed to ascertain its original composition. Had we any means of distinguishing between the butyric acid formed by the fermentation of lactic acid, and the butyric acid liberated by separation from the glyceride of butyric acid, the problem might, perhaps, be simplified. I have found the analysis of milk, kept so as to have a butyric or cheesy odour, to yield most discrepant results, especially in the amount of solids not fat; and no reliance can be placed upon the analytical figures, except those relating to the ash. Nevertheless

considerable light may be thrown upon the genuineness of even a putrid milk by a determination of the amount of ash, and of the chlorine present in this. Two precautions are, however, necessary—to determine the ash of a sufficiently large quantity of the milk (20 c.c. at least), and to determine the chlorine in a separate portion of ash from a portion of the milk evaporated with a slight excess of sodium carbonate, in order to avoid loss of chlorine. An analyst, then, may generally with safety undertake the analysis of a milk which has simply undergone the lactic fermentation; but when the sample has advanced a stage further, and the butyric or cheesy odour is perceptible, no certain and reliable results are attainable, and a probable opinion only can be given as to the genuineness of the article, based upon the determination of the ash and the chlorine in the ash. In connection with this I may direct attention to the recent researches of G. Bunge (*Zeitschr. f. Biologie*, Bd. x., p. 295), on the variations in the quantities of the alkaline chlorides in milk. It is usually assumed that the chlorine in cow's milk is very constant, and forms one-tenth of the ash, *i.e.*, is about 0·07 per cent of the whole milk. There is, however, always a slight loss of chlorine during the incineration of a milk residue, except a little alkali be added before evaporation. This loss is usually, with careful incineration, 6 or 7 per cent of the total chlorine. Bunge shows that the chlorine in milk ash is far from constant. He found, in fact, the chlorine to vary from 0·098 to 0·211 grm. in 100 c.c. of cow's milk. In fact, the quantity of chlorine in milk may vary so much as 100 per cent, according to the manner of common salt taken in the food. Too much importance, therefore, ought not to be attached to the presence of an excess of chlorine in milk ash, so long as the chlorine does not form more than about 0·2 per cent of the whole milk.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

The first Annual Report of the President, Prof. Gladstone, F.R.S., and Council, shows that the formation of the Society has been in every way attended with very gratifying results.

The meetings were commenced under singularly favourable circumstances, as the Lords of the Committee of Council on Education generously placed the Physical Laboratories and Lecture Rooms at the disposal of the Society.

It may be mentioned that the success of the Society is due in no small measure to the care and energy of Dr. Guthrie, Professor of Physics at the Royal School of Mines.

The first paper was on the "*New Contact Theory of the Galvanic Cell*," by J. A. Fleming, B.Sc., and many valuable communications have been read during the year.

The Society has already lost a very able member by the death of Dr. W. S. Davis, of Derby, at the early age of thirty-two years:—

The following is the list of Officers and Council for the present year:—

President—Prof. J. H. Gladstone, F.R.S.

Vice-Presidents—Prof. W. G. Adams, F.R.S.; Prof. G. C. Foster, F.R.S.

Secretaries—Prof. A. W. Reinold, M.A.; W. Chandler Roberts.

Treasurer—Dr. E. Atkinson.

Demonstrator—Dr. F. Guthrie, F.R.S.

Other Members of Council—Latimer Clark, C.E.; W. Crookes, F.R.S.; Prof. A. Dupré; Prof. O. Henrici, F.R.S.; W. Huggins, F.R.S.; Prof. H. M'Leod; W. Spottiswoode, F.R.S.; Dr. H. Sprengel; Dr. W. Stone; E. O. W. Whitehouse.

CORRESPONDENCE.

DOUBTFUL MINERALS.

To the Editor of the Chemical News.

Sir,—Please to afford me space for a few last words on Doubtful Minerals and Double Nomenclature, inasmuch as Professors Maskelyne, How, and Burghardt have honoured me by some pertinent and valuable remarks on my previous communications.

I very much regret that my letters have laid me open to the suspicion of a desire to mark with a slur the fair names of Dana and Maskelyne. I had so such thought; for, most certainly, the learned professors who bear these distinguished names cannot, in any sense, be classed with the "doubtful."

These talented presidents of the Republic of Minerals hold important positions of pretty equal elevation; but, betwixt them there is a great gulf fixed, and there is no Colossus of Rhodes to bestride it. Each has been exercising the questioned right of private judgment, and using spectacles tinted to suit his own particular sight. Some disciples, out of compliment to both, have been borrowing a lens from each, and whilst thus clouding their vision have sighed through divided affection, "How happy could I be with either, were t'other dear charmer away." &c.

These potentates, uninterrupted, for some time have been involved in an amiable war of words; and, although just now, it happens, they only shot their guns with persistent "yea" and "nay," the pellets, nevertheless, cause a good deal of fluttering in the flock of very small birds who peck at the food in the great men's hands. Fortunately, anywhere, "cats *may* look at kings."

Dana and Maskelyne, by English students, are looked up to as Mineral sponsors and authorised Registrars. But, the students say, our masters are so much at variance; they have a habit of calling names across the Atlantic, which may be equal to the same thing, but are not equal to one another. This habit bothers them a good deal, because they say the names themselves are not even echoes of each other to help the identity of things signified. For example, chalcopyrite is authoritatively flashed by cablegram from Yale College, and *presto*, it is changed into copper pyrites at the British Museum! Dana, all the while sheltering himself under the popular notion that "The Greek language is the most approved source of names." Be it so. Therefore χαλκος, the Greek for *Brass*, is made an equivalent of yellow or copper, or of both together. Surely it is a small matter that Henckel, in his Pyritology (1725), wrote of *chalcopyrites*, "it is a very good distinctive name for the ore." It happens that it was called kupferkies at least 150 years earlier than that date; so then, by virtue of Dana's new law, the German word ought to claim priority of choice, always assuming some advantage in the resuscitation of either. I half blush to write it, but *yellow copper ore* is a distinctive expression wherever English is spoken, and those who like it will continue to use it whilst the ore is of any value in the mineral market. To my weak mind, chalcopyrite no more explains copper pyrites than the *Meus porcus et ego* of my boyhood explained mahogany.

There never will come a time, perhaps, when all minerals will be called by appropriately suggestive names: that is no reason, however, why we should not presently try to exterminate the hoard of *aliases* that now beset us. These aliases are enormous nuisances, and in being their open enemy (it is not to serve any selfish motive), I do but contend, in the interests of common humanity, for something like uniformity of nomenclature. Any radical changes of name ought to be made, I think, more in conformity with what's what than with who's who. Maskelyne's alteration of Smithsonite to hemimorphite, to wit.

Not having any pet names of my own to substitute, I

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could contentedly take the catalogues of Maskelyne and Dana, and as to the discrepancies draw lots for the preference, and thus clear the fencing at a bound. The *pedigree* of minerals might be left at the Herald's College, or better it may be at the British Museum, alongside the Assyrian tablets, containing the legend of the building of the Tower of Babel. Let us, if we can, have one name for one thing, and stick to it. In fact, minerals might be easier recollected *numerally* than by the present absurd and unscientific practice of bandying personal baptismal compliments, &c.

The great burden of the mineral student's song is the obligation to do *double duty*, in the way of recollection. To some this is found almost impossible; to many it is most irksome, and to all it is a tax upon life-time, more iniquitous by half than the income tax. Besides, there is neither useful knowledge nor recreation to be got out of such continuous fagging. I don't at all object to being called *tar* on this side the salt ocean, but I strongly object to being called *pitch* on the other. Any sensitive substance would, because there is no advantage in the duality to anybody, and one might be mistaken for the other in transit. This dual-miasma has given me a kind of intermittent fever, worse than is caught in the Campagnia; and, when the fit is on, I seek relief in my antiseptic initials. I sometimes find it, and am now hopefully looking forward to the time when I may put myself into the attitude of the tail-piece of Bristow's Glossary, for the correspondence so far has resulted favourably in the reduction of the "Doubtful Minerals," and I dare say this dual business will be cleared up some day; and now a parting word to my kind observers.

Professor Maskelyne in his letter gratifies me immensely. He unhesitatingly declines "to defend a cause which is essentially a bad one." His declaration is at once manly and judicious. He writes, "Responsible, not only to Englishmen, but to the whole world, for whom this collection is becoming a sort of metropolitan collection, I have shrunk from the extensive changes in the nomenclature that the adoption of Dana's names would involve." May he long enjoy the same temperature.

I cannot anywhere have even hinted that mineralogists are likely to be misled by Maskelyne's nomenclature, for I think just the contrary. But, when Dana's standard, and by far the completest work on mineralogy in the English, and, perhaps, in any other language, differs so very widely from the British Museum catalogue, the fact is by no means insignificant or unimportant, especially as we have no British book corresponding with Dana's for authoritative guidance.

If I were Chancellor of the Imperial Exchequer, I should have an exceedingly strong desire to double the remuneration of all the courteous officials in the public Natural History Departments, and should, most certainly, propose a special grant of at least £5000 a year, for the publication, periodically, of all the new and interesting facts in relation to natural history that might be acquired by them in the interim. This done, light would not remain hid under a bushel as now—talent would actually escape from its folded napkins, and the world would get a thick "quarterly" of estimable interest and value, in lieu of the scrubby catalogues and papers that are only occasionally afforded to the enquiring multitudes of whom I am an obscure unit. It may not be any part of the ordinary duty of the present courteous officials to write memoirs or amplified descriptive catalogues; but it might be, to the advantage of everybody, as your own pages show, in the abstracts of recent lectures of the highest possible order on the "Morphology of Crystals."

That matchless accumulation of minerals, empty shells, and stuffed skins at the British Museum always appears to me to be making signs for music of some kind, either that it may be less monotonous as a dumb show (as at an exhibition of waxwork), or for spirit-stirring human tongues to tell out its latent excellencies, not exclusively to select and learned societies, but to the unlearned and gaping crowds—the children of all ages, rank, and condition—who come at leisure to look at the "pretty things." With plenty of food in the store, the hunger and thirst after knowledge might be easily appeased.

To Professor How I owe an apology for an offence against his good taste; and I will confess that when I wrote the first letter I was not at all intent on turning delicate periods, and certainly not on annoying him or anybody else. I do not, however, altogether regret having written it, for the world now knows by this time, through your Journal, that How's "Cyanolite" is fully described in the *Edinburgh New Philosophical Journal*, 1859, and that he is himself in possession of the veritable mineral. Dana (1868) refers to *Edin. New Phil. Journ.*, x., 84, 1859 (341 B) for How's Cyanolite. Inadvertently, I mistook this contracted reference for some American Journal out of my reach, and I merely noted Dana's remark that cyanolite "is probably the same mineral with centrallassite, impure with much more silica or chalcedony, impure with centrallassite." Dana (1874) makes no further allusion to it: hence its place in my list of "Doubtful Minerals." It is now said by Dr. Burghardt to be "simply okenite." How he arrives at this conclusion he does not say. Without in the slightest degree doubting the accuracy of How's analyses, I wish somebody would just steam to the Black Rock of the Bay of Fundy, and send a lump of the mineral to the British Museum, that the facts of this triple alliance of cerinite, cyanolite, and centrallassite may be definitely settled. Still, after the Professor's expostulation, we cannot find it in our stoney heart to hang the pet he hugs so tenderly.

My neighbour Dr. Burghardt hopes that my "mind will at last be set at rest." He is not alone in that hope. To a great extent I have got over the "confusion of tongues." He says, in his last letter, "He might have saved himself all this trouble by studying *German* books on the subject." Not so, however, for I have tried it. He says also that, "In mineralogy we are immeasurably behind Germany." Not exactly the fact either. English mineralogists, for the most part, are familiar with German scientific literature. It is not long in finding its way to England, where English professors read it in due course, and profit accordingly. What becomes of all the new mineralogical facts is quite a different question. They sometimes appear in the *Family Herald*, of all odd places, amongst the conundrums! "*Dawsonite*" popped up the other day in *Public Opinion!* What and where next? Perhaps, in the end public opinion may be brought to bear on the question, and names of minerals may become household words. All natural history facts ought, it seems to me, to find a central station, and not merely a resting-place, at the British Museum; and should be thence disseminated somehow (I would almost say anyhow) officially. I do not indeed "forget that there are other languages besides English." I am aware that Germans are not all dull, and that Englishmen are not all brilliant. I am aware also that the English language is not necessarily inexpressive, and that it is gradually and rapidly becoming universal. I know, therefore, of no reason why an English scientific book should necessarily compare unfavourably with one in any other language. Thackeray used to say, to the effect, that books which are written compare unfavourably with the books which might be written. Many persons now think so. Frankly, I much prefer the German mineral nomenclature to the mongrel Greek and personality that has been foisted on us, although, at the same, I should not always like to go the length of Nickelthoneisenzinksilicat, nothwithstanding its analytical expressiveness.

Indeed, I have not been the author of any "of the confusion in the names of minerals." My small efforts have been quite in the other direction.

I follow Maskelyne and Dana as far as they go, and anybody else who goes further. What more can I do? My great difficulty is in properly treating what may be

called the *Mineralogical Orphans*, fallen out of the ranks from unknown causes or weakness of constitution. Some of their parents and sponsors have been dead a very long while, and nobody appears to know where many of them came from. I don't care to keep an asylum for them any longer, but wish them to die a natural death, and to be sanitarily buried, or cremated (if preferred) clean out of sight and out of mind.

Dr. Burghardt has contributed several items to the credit of this account and the common good, and for one I thank him. By the way, I didn't say that stilbite was an antimony mineral. I did know better than that, and stillolite I called an outcast. Dr. B. says, "As to stillolite, no such name is known to modern mineralogists." Just so; but it used to be the name of a variety of siliceous sinter. Thomson (1854) mentioned it as "allied to opal." Dana (1874) puts "stillolite *v.* opal" in the "Index Expurgatorius." The poor thing therefore, having now no friends, peradventure we may safely make an end of it here.

I feel rewarded in having drawn attention to this important subject in the proper quarters, and I believe the *desideratum* to be not very far distant. My next communication shall be as concise as this has been verbose.

T. A. R.

Feb. 15, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 15, November 9, 1874.

Siljeström's Experiments for Determining the Changes of Density of Diluted Gases.—D. Mendelejeff.—A mathematical paper; not adapted for abstraction.

Remarks on the Influence of the Alkaloids upon Certain Properties of Hæmoglobin.—E. Schaer.—The author calls in question certain views put forward in Rossbach's *Pharmakologischen Untersuchungen*, that is, that the transference of ozone by means of hæmoglobin is checked by quinine; and, further, that both the oxidation of the blood by means of atmospheric oxygen, and the formation and separation of carbonic acid, are checked by many alkaloids. The author considers that all conclusions as to the suspension of the transference of ozone by means of the action of alkaloids should be regarded with extraordinary caution; and that a rational interpretation of the influence of quinine as regards the thermometric decrease of the processes of organisation in the organism, must be attempted from other points of view.

Communications from the Griefswald Laboratory.—H. Limpricht.—These communications relate to a new method of preparing the amido-sulph-acids; a further examination of compounds derived from ortho-amido-para-sulpho-toluolic acid, by M. Hayduck (*Berichte*, p. 552); and a paper on the "position" of the nitro group in the nitro compounds of ortho- and para-brom toluol.

Isomeric Nitro-Toluylic Acids, Azo-Toluylic Acids, and a Second Cymol Sulph-Acid.—F. Fittica.—This paper consists of hypothetical speculations.

Oxidation Products of Isobutylic Alcohol.—Ernst Schmidt.—A confirmation of the view of Kraemer that acetone is found among the normal products of the oxidation of isobutylic alcohol.

On Chrysen.—Ernst Schmidt.—The author has not succeeded in detecting chrysen among the condensation products of benzol, as maintained by Berthelot (*Bull. Soc. Chim.*, vi., p. 276).

Sulph-Acids of Naphthylamin.—Ernst Schmidt and Beruh. Schaal.—The authors have attempted the preparation of the various isomeric sulph-acids of the formula

$$C_{10}H_6\begin{cases}NH_2\\SO_3H\end{cases}$$

and the comparison of their properties and products of decomposition.

Di-Iso-Propyl-Keton and Methyl-Iso-Propyl-Keton.—R. Münde.—The former of these compounds is sparingly soluble in water, but readily and in all proportions in alcohol and ether. Acid alkaline sulphites do not combine with it. It reduces ammoniacal solutions of silver. Its oxidation produces isobutyric, acetic, and carbonic acids. Nascent hydrogen transforms di-iso-propyl-keton into a secondary alcohol of the group of the heptyl compounds, and at the same time into oily products, boiling at high temperatures. Methyl-iso-propyl-keton is a clear liquid of pleasant odour, boiling at 93° to 94°, and having the sp. gr. 0·811 at 15° C. With bisulphite of soda it forms a crystalline compound, but has no action upon ammoniacal solutions of silver. Oxidising agents resolve it into acetic and carbonic acids, and water.

On Ortho-Dinitro-Benzol.—A. Rinne and T. Zincke. The authors have succeeded in obtaining a third dinitro-benzol belonging to the ortho series (*Berichte*, vii., p. 869). It fuses at 117° to 118°; sublimes at higher temperatures in fine fern-like leaflets. In hot alcohol it dissolves readily, more easily than the para, but less easily than the meta compound. It is slightly soluble in hot water, in which the para compound is almost insoluble. From its solutions in alcohol, benzol, and chloroform it may be obtained in fine tabular crystals of the rhombic or monoclinar system.

Levulic Acid formed during the Action of Sulphuric Acid upon Sugar.—A. von Grote and B. Tollens.—The new acid is most easily obtained from the levulose produced by the inversion of cane-sugar. It crystallises in fine leaflets, is capable of distillation, and the most of its salts are crystalline. Its composition is $C_5H_8O_3$. The authors have examined the zinc, lime, potash, and silver salts.

Presence of Allylic Alcohol among the Products of the Dry Distillation of Wood.—B. Aronheim.—The author demonstrates the presence of allylic alcohol in ordinary wood-spirit.

Cyan-Acetic Acid.—J. van't Hoff.—Already noticed.

Action of Ammonia on Aceton.—N. Sokoloff and P. Latschinoff.—At common temperatures aceton absorbs 8·5 per cent of its weight of ammoniacal gas. Städeler's aceton-ammonia is not formed. Aceton purified according to the method of Saint Gilles is not resolved into aldehyd and methylamin. If aldehyd saturated with ammonia is allowed to stand at an ordinary temperature for three to four weeks, and is then mixed with the quantity of pulverised ammonia necessary to form an acid salt, a crystalline precipitate is at once formed, which, on treatment with boiling alcohol (of 95°), is resolved into insoluble oxalate of ammonia, and a soluble salt of the base $C_6H_{13}NO$. This base Heintz named diacetonamin, but the authors consider it should be called diacetonhydramin.

Certain Compounds of the Sulphide of Mercury.—Karl Heumann.—The white body mentioned in the author's paper (*Berichte*, vii., p. 752) is identical with the white precipitate obtained by passing a small quantity of sulphuretted hydrogen into the solution of mercuric nitrate. Palm and Barfœd have made known a series of analogous compounds, combinations of mercuric sulphide with various salts of the same metal. The blackening of these precipitates by alkalies depends on the separation of mercuric sulphide. Palm asserts the existence of analogous red-addition products, formed by cinnabar with the salts of mercury. Barfœd disputes this view, having obtained with cinnabar the same white compound as with the black amorphous sulphide. The author's experiments confirm those of Barfœd.

Action of Chloride of Copper upon Sulphide of Mercury.—Karl Heumann.—The author obtained a compound of these bodies in the form of a brilliant orange powder, containing—

Mercury..	60·44
Copper	19·16
Sulphur..	9·67
Chlorine	10·72
	99·99

Communications from the Greifswald Laboratory.—H. Limpricht.—Ortho-toluydin sulph-acid was converted into the diazo compound, and this again into brom-sulpho-toluolic acid, the salts of which are here examined.

Connection of Substituted Benzols and Phenols.—F. Beilstein and A. Kurbatow.—On comparing the physical properties of the three isomeric series it is found that the para compounds are mostly solid, have the highest melting- and boiling-points, and are the most permanent. The ortho derivatives are generally liquid, and have the lowest melting- and boiling-points. The meta bodies hold an intermediate place.

Derivatives of Methyl-Diphenylamin.—R. Gnehm.—The author has come upon substances very closely connected, and possibly identical with the dipara-pikrylamin and barium dipara-pikryldiamin of Austen.

Diffusion of Gases through Soap-Bubbles.—F. C. G. Müller. A preliminary communication. The author describes an experiment proving that gases may be diffused through thin layers of liquids.

Answer to Struve's Reclamation.—M. Traube.—A controversial paper relative to the behaviour of alcoholic yeast in media free from oxygen gas (See *Berichte*, vii., p, 872).

Action of Oxide of Silver on Bichlorpropionic Ether obtained from Pyruvic Acid.—E. Klimenko.—A preliminary announcement.

Reply.—C. Liebermann.—A comment on Schmidt's reply to the charge that his treatise on anthracen and chrysen is substantially a repetition of the author's researches on chrysen.

Compounds of Mono-Chlor-Aldehyd with Aromatic Hydrocarbons.—E. Hepp.—This paper, which is not adapted for abstraction, is a continuation of the Strassburg researches on the synthetic preparation of the aromatic compounds.

Alcoholic Fermentation.—F. Mohr.—A refutation of the views of Brefeld.

Worm-Seed Oil and Cymen.—A. Faust and J. Homeyer.—The authors consider the identity of cymen and cymol no longer doubtful.

Eucalyptus Oil.—A. Faust and J. Homeyer.—The authors examine two bodies found in eucalyptus oil, $C_{10}H_{16}$ and $C_{10}H_{14}O$.

Condensation of Higher Ketons.—O. Jacobson.—Not adapted for abstraction.

Changes of Position in the Aromatic Series.—E. Demole.—An examination of iodosalicylic acids; the action of melting potash upon pure di-iodosalicylic acid; and action of heat upon pure oxysalicylic acid.

Liebig's Annalen der Chemie und Pharmacie.
Heft 1 and 2, 1874.

Communications from the Laboratory of Professor Wislicenus, at Wurzburg.—These consists of a paper on the constitution of phosphorous acid, ethylester, and of phosphorous acid, by Dr. Carl Zimmerman; remarks on the conversion of substituted thio-uric matters into guanidins, by Dr. Carl Foster; and a memoir on the action of ethyliden-oxychloride upon zinc-ethyl, by Dr. Fried. Kessel.

On Gentisin (Gentianin).—H. Hlasiwetz and J. Hubermann.—This body was discovered by Henry and Caventon in the root of *Gentiana lutea*, where it is present in small quantity. On ultimate analysis, the authors found that it contained—Carbon, 64·85; and hydrogen, 4 per cent; results which agree very closely with those formerly obtained by Baumert, and are compatible with his formula, $C_{14}H_{10}O_5$. They succeeded in producing a gentisic acid, which fuses at 197°, and crystallises without water. Its analysis leads to the formula $C_7H_6O_4$, identical with those of protocatechuic acid, dioxybenzoic acid, oxysalicylic acid, and hypogallic acid; with none of which, however, it is identical, as the authors show by a comparative table of its reactions.

Researches on the Biliary Colouring Matters.—R. Maly.—(See *Annalen*, 163, p. 77.) An examination of bilirubin and biliverdin. The author points out the presence of the former pigment in the gall-stones of oxen.

Communications from the Laboratory of Professor V. Meyer, in Zurich.—These consist of a memoir on the nitro compounds of the fatty series, by V. Meyer; a note on the history of hydroxylamin, by the same chemist; a paper on primary iso-nitro-butan, by E. Demole; and contributions to the knowledge of the azo compounds, by W. Michler.

Nature and Composition of Tannic Acid.—Hugo Schiff.—An examination of the tannates, especially those of ammonia, potash, soda, baryta, antimony, bismuth, copper, mercury, cadmium, lead, and iron.

Researches on the Carbo-Hydrates.—These consist of a memoir upon the acid (levulic) produced by the action of sulphuric acid upon sugar, by A. von Grote and B. Tollens; and a paper on vegetable mucus by W. Kirchner and B. Tollens. The kinds examined are those of the quince and linseed.

Note on Hydrated Parabanic Acid.—B. Tollens.—The author defends the value of his method for preparing this acid against Menschutkin (*Annalen*, 172, p. 175).

MISCELLANEOUS.

The Chair of Natural History in the University of St. Andrews has been offered to and accepted by Prof. Alleyne Nicholson, of the College of Physical Science, Newcastle-on-Tyne. Dr. Nicholson was in no way a candidate, directly or indirectly, for this appointment, but in thus offering it to him unsolicited, the Marquess of Ailsa has the cordial approbation of the University authorities, and may be congratulated in securing for the chair, of which he is patron, so distinguished a naturalist and professor, whose experience extends over two continents.—*Scotsman, February* 22.

MEETINGS FOR THE WEEK.

MONDAY, March 8th.—Medical, 8.
—— Geographical, 8.30.
—— London Institution, 5.
TUESDAY, 9th.—Civil Engineers, 8.
—— Photographic, 8.
—— Anthropological, 8.
—— Royal Institution, 3. Alfred H. Garrod, Esq., "On Animal Locomotion."
WEDNESDAY, 10th.—Geological, 8.
—— Society of Arts, 8.
THURSDAY, 11th.—Royal, 8.30.
—— Royal Institution, 3. Professor Tyndall, "On Subjects Connected with Electricity."
—— Royal Society Club, 6.30.
FRIDAY, 12th.—Royal Institution, 8. Weekly Evening Meeting. Prof. Abel, "On Accidental Explosions," 9.
—— Geologists' Association, 8.
—— Quekett Club, 8.
—— Anthropological, 7.30.
SATURDAY 13th.—Royal Institution, 3 Prof. W. K. Clifford, "On the General Features of the History of Science."

TO CORRESPONDENTS.

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A Reader.—Disulphide of carbon.

THE CHEMICAL NEWS.

VOL. XXXI. No. 798.

THE NATURE AND CONSTITUTION OF CAMPHOR AND PHORONE.

By C. T. BLANSHARD.

FROM the fact that camphor differs from borneol by the loss of H_2, Berthelot inferred that camphor is an aldehyd. Fittig and Tollens have shown (*Ann. der Chem. u. Pharm.*, cxxix., 377) that camphor has none of the properties of an aldehyd, because—

(1). When heated in a sealed tube with potassium chromate and sulphuric acid, it does not oxidise to $C_{10}H_{16}O_2$, and no acid less oxygenised than $C_{10}H_{18}O_4$, camphoric acid, results from the oxidation of camphor; Berthelot's camphic acid ($C_{10}H_{16}O_2$) being, according to Kachler, only impure campholic acid ($C_{10}H_{18}O_2$).

(2). It does not reproduce borneol when treated with sodium amalgam, either in alcohol or acetic acid.

(3). It forms no compound with $NaHSO_3$.

(4). They were not able to reduce camphoric acid to Berthelot's camphic acid by means of iodide of phosphorus and water.

As camphor was regarded as an aldehyd, without sufficient reason, so, from a solitary reaction, that of its formation, has phorone been called a ketone. The dibasic acids have no ketones. Suberone, the only other body derived from a dibasic acid that has been classified with the acetones, has none of their properties, being oxidised to suberic acid by means of nitric acid. In the formation of camphorone (phorone) according to the following equation:—

$$C_{10}H_{14}CaO_4 = CaCO_3 + C_9H_{14}O,$$

there is no condensation of the carbon by the union of two alcohol radicals with (CO), as in the case of the ketones.

The reactions of camphor and phorone, which, as far as they have been studied, are exactly similar, show that these bodies are allied to the phenols.

(1). With PCl_5, they react to form, respectively, the chlorides $C_{10}H_{15}Cl$ and $C_9H_{13}Cl$, the latter being insoluble in water and soluble in alcohol.

(2). The body $C_9H_{13}Cl$, treated with ammonia, yields the hydrochlorate of $C_9H_{13}H_2N$, the amide.

(3). Potassium acts on both camphor and phorone, like phenols, replacing 1 atom of hydrogen in each.

The sodium compound of camphor $C_{10}H_{15}NaO$ (sodium camphate) reacts with ethyl iodide to form the ether $C_{10}H_{15}(C_2H_5)O$ (Baubigny).

(4). They behave, when dehydrated by zinc chloride (Gerhardt), like ordinary alcohol, yielding the hydrocarbons less by H_2 than those from which they are derived, thus:—

$$\text{I. } \underbrace{C_9H_{14}O}_{\text{Phorone.}} = H_2O + \underbrace{C_9H_{12}}_{\text{Cumene.}}.$$

$$\text{II. } \underbrace{C_{10}H_{16}O}_{\text{Camphor.}} = H_2O + \underbrace{C_{10}H_{14}}_{\text{Cymene.}}.$$

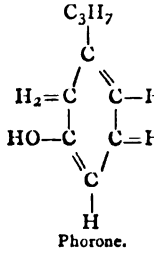
Thus, all the reactions of camphor and phorone show that they are phenols, and not aldehyds or ketones.

As regards the constitution of these bodies, camphor is cymene (methyl-propyl-benzene) + the elements of water, and phorone is cumene (propyl-benzene) + the elements of water. They are not alcohols, but phenols, as their reactions with metallic potassium and sodium show, coupled with the formation, in the case of phorone, of chloride and amide, and in the case of camphor, of the ether. They are therefore analogous to the complex phenols, *e.g.*, picric acids. They may be classed as aromatic bodies, *i.e.*, bodies allied to, and derived from, benzene; for—

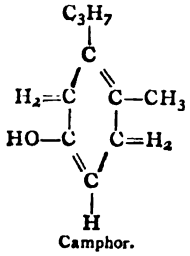
(1). Camphor is readily and largely soluble in aniline, according to Schiff (*Annalen*, Supp. 3, 361).

(2). By dehydration they yield homologues of benzene.

They may, therefore, be thus represented, according to Kekulé's graphical formulæ:—



Phorone.



Camphor.

The positions of the (CH_3) in camphor, and the (OH) in both camphor and phorone, have yet to be determined for their various isomeric modifications. There should be six modifications of each, the grouping (C_3H_7) being either propyl or isopropyl. The two bodies are thus represented as being exactly analogous, camphor (methyl-phorone) being the homologue of phorone.

When dehydrating agents act on either of these bodies, a hydrogen atom out of each of the (CH_2) groupings unites with the oxygen atom to form water, just as phenol is reduced to benzene by means of zinc fume; the carbon atoms then unite together, as represented in Kekulé's nucleus, to form in each case a homologue of benzene.

Queen's College, Oxford,
March 11th, 1875.

LECTURES ON THE MORPHOLOGY OF CRYSTALS AT THE CHEMICAL SOCIETY.

By NEVIL STORY MASKELYNE, M.A., F.R.S., &c.

(Continued from page 64).

LECTURE X.

THE case which came under consideration in the orthorhombic system of a pole lying on one of the great circles of symmetry—*e.g.*, on C at an equal distance from the planes S and Σ—is that in which a transition is made from the orthorhombic system to the tetragonal system. The zone circle passing through such a pole perpendicularly to the great circle, C, fulfils, as we have seen, the conditions for a plane of symmetry. The result of its being so is, that the planes S and Σ are now identical in character—that is to say, are conformable to each other—and we shall indicate them by the same letter, as S_1 and S_2. The new plane of symmetry, and the supplementary plane corresponding to it, being similar, will be indicated by the letters Σ_1, Σ_2, and the systematic triangle of the system will be designated by the expression—

$$S = \Sigma = \frac{\pi}{2} \qquad C = \frac{\pi}{4}$$

$$s = \sigma = 90^\circ \quad c = 45^\circ,$$

and the surface of the sphere will be divided into sixteen such triangles.

Taking the planes S as the proto-systematic planes, and the planes Σ and *c* for the deutero- and trito-systematic planes, respectively, the zone axis [S Σ], which is the normal of the plane *c*, becomes the morphological axis of the system; and taking the planes S and C for axial planes, their normals present to us three perpendicular axes. A face of a form, the poles of which lie on the great circle, Σ, serves for a parametral plane; and, since the poles of such a face cannot bisect the side, Σ, of a systematic triangle, for the reason already discussed, the face in question

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will intersect with the three axes, X and Y, at the same distance *a*, but with the axis Z with some other parameter, *c*, so that the axial system becomes—

$$\xi=\eta=\zeta=90;\ 1,\ 1,\ \frac{c}{a}.$$

The seven forms of this system are—

1. $\{h\,k\,l\}$ the scalene di-octahedron.
2. $\{h\,o\,l\}$ the isosceles prot-octahedron, or *axial* octahedron.
3. $\{h\,h\,l\}$ the isosceles deutero-octahedron, or *diagonal* octahedron.
4. $\{h\,k\,o\}$ the di-tetragonal prism.
5. $\{1\,0\,0\}$ the tetragonal proto-prism, or axial square prism.
6. $\{1\,1\,0\}$ the tetragonal deutero-prism, or diagonal square prism.
7. $\{0\,0\,1\}$ the tetragonal pinakoid, or *axial* forms.

Of these the "proto-forms" are those of which the poles lie on the great circles S, while the "deutero-forms" or *diagonal* forms have their poles on the great circles Σ.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 4th, 1875.

Professor Odling, F.R.S., President, in the Chair.

The minutes of the previous meeting were read and confirmed, after which Messrs. J. W. Thomas and Henry Shephard were formally admitted Fellows of the Society. The names read for the first time were those of Messrs. M. W. Williams, J. Wilson, and G. E. Davis. Messrs. Charles Thomas Whitmell, B.A., Thomas Howard, Ernest Laremont Fleming, Joseph John Ackworth, Alfred Senier, M.D., Joseph G. Gordon, and James Wilson Bell, and Captain Douglas Galton, F.R.S., were ballotted for and duly elected after their names had been read for the third time.

The first paper, "*On the Dissociation of Nitric Acid*," by Messrs. P. Braham and J. W. Gatehouse," was read by the former. Three series of experiments were made, the first of which consisted in exposing the vapour of the acid (sp. gr. 1·5) to various temperatures; at that of melted tin only 2·5 per cent of the acid was decomposed, whilst at that of melted lead 20 to 30 per cent was affected, and at a low red heat 54 per cent; at a bright red heat 89. The products are tetroxide of nitrogen, nitrous oxide, oxygen, and nitrogen, the reaction being represented by the equation $8HNO_3=4NO_2+4OH_2+N_2O+N_2+O_{11}$. A very neat experimental illustration was shown by pouring nitric acid into the bowl of a tobacco-pipe placed in an inclined position, and the stem of which was heated to redness; the evolved gas was collected over water. In the second series, where the acid was exposed to sunlight, it was found that decomposition ceased before the amount of nitrous acid had reached 1·5 per cent. If, however, the products of decomposition are removed as they are formed, the action continues. From the third series of experiments it was found that nitric acid containing nitrous acid is not decomposed by boiling.

The President said the Society was much indebted to the authors for their paper, and especially for the very neat lecture experiment which they had shown.

Dr. Armstrong observed that Mr. Braham had asked for a simple method of analysing a mixture of nitric peroxide, nitrous oxide, oxygen, and nitrogen. He might suggest that a coke ball saturated with sulphuric anhydride would absorb the nitric oxide without affecting the nitrous oxide, and the other gases could then be determined in the usual way.

Mr. Braham then exhibited an experiment, in which he exhausted a glass receiver; and after allowing the air to re-enter through a large opening until equilibrium was restored, the opening was closed, and the vessel connected with a pressure gauge. In the course of a minute the mercury had risen through the space of an inch. A converse experiment was made by pumping air into a glass vessel, allowing it to escape, and then closing the opening. In a short time there was an appreciable pressure within the vessel.

Many suggestions were offered by various members of the Society in explanation of these phenomena, after which Dr. Thudichum addressed the Society "*On the Chemical Constitution of the Brain.*" He said he thought the best way of bringing the substance of his researches before the Society would be to explain the table of the constituents of the brain which was hanging on the wall:—

Table showing Constituents of the Brain.

Group of Sulphurised Principles.

Albumin, $C_{72}H_{112}N_{18}SO_{22}$

Group of Phosphorised Principles.

Sub-group of Kephalins.

Kephalin, $C_{42}H_{79}NPO_{13}$
Kephaloidin, $C_{42}H_{79}NPO_{13}$
Oxykephalin, $C_{42}H_{79}NPO_{14}$
Peroxykephalin, $C_{42}H_{79}NPO_{15}$
Amido-kephalin, $C_{42}H_{80}N_2PO_{13}$
Compounds with $PtCl_4$; $CdCl_2$; Pb; acids, bases, and salts.

Sub-group of Myelins.

Myelin, $C_{40}H_{85}NPO_8$
Oxymyelin, $C_{40}H_{75}NPO_{10}$
Amido-myelin, $C_{40}H_{82}N_2PO_{10}$
Compounds as kephalin.

Sub-group of Lecithins.

Lecithin, $C_{42}H_{83}NPO_9$
Compounds as kephalin.

Group of Nitrogenised Principles.

Cerebrin, $C_{34}H_{68}N_2O_8$
Stearoconote, $C_{34}H_{68}N_2O_8$
Phrenosin. $C_{34}H_{67}NO_8$
Kerasin, $C_{46}H_{91}NO_9$
Extractive and secretory acids.
Uric acid and congeners.
New acid.
Extractive alkaloids, No. 1 and No. 2.
Urea and amido-acids.

Group of Oxygenated Principles.

Cholesterin, $C_{26}H_{44}O$
Inosite, $C_6H_{12}O_6$
Lactic and formic acids.
Fats and fatty acids.

Group of Inorganic Principles.

H_2SO_4; HCl; P_2O_5; CO_2; H_2OK; Na; NH_3; Ca; Mg; Cu; Fe; Mn.

This subject, which was one of great difficulty, had occupied him many years, and he had found that it was quite useless to work on the small scale; in fact, before anything could be done, 1000 brains had to be subjected to chemical examination. Of the constituents of the brain, nearly all the albumin present was in the insoluble form. The group of the phosphorised principles, to which he had principally directed his attention, consisting of the kephalins, myelins, and lecithins, all contained phosphorus, as glycero-phosphoric acid. There were also present nitrogenised principles, oxygenised principles, inorganic matter, and about 80 per cent of water. The water is very difficult to remove from the brain matter, but it can be done by slicing it thin, and soaking it in successive quantities of strong alcohol. The dried product is then finely divided and rubbed through a sieve. Heated to 45° C. with alcohol,

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it leaves albumin, and the solution deposits a white matter, containing most of the phosporised principles, all the nitrogenised, and much of the cholesterin. The alcoholic solution, when concentrated, deposits the lecithins, and by further evaporation the fatty ethers. The constituents of the white matter may be separated by treatment with ether, which extracts the kephalins; on concentrating the solution and adding alcohol, these are precipitated. The myelins are only slightly soluble in ether, but may be dissolved out by absolute alcohol, which leaves the cerebrin, phrenosin, and kerasin.

All the phosphorised principles are soluble in water, but the kephalins as a class are characterised by the property of oxidisability, turning red in contact with ether, whilst the myelins, on the contrary, possess great stability, and are therefore readily obtained colourless and crystallised. Hydrochloric acid, or any salt, readily precipitates the phosphorised compounds, but when dialysed the combined reagents pass off, and the substances again pass into solution, affording an excellent method of purifying them. The phosphorus is always present as glycero-phosphoric acid.

The author then explained his theory of the constitutional structure of the various compounds, after which he shortly noticed the members of the nitrogenised group, of which phrenosin, $C_{34}H_{67}NO_8$ may be considered as the monoamidated form of a fatty acid, whilst cerebrin, $C_{34}H_{68}N_2O_8$ is the diamidated form. Kerasin, $C_{46}H_{91}NO_9$, the third on the list, is a colourless crystalline substance. All these compounds give a purple colour when treated with sulphuric acid and sugar (Pettenkofer's reaction). Stearoconote has the same composition as cerebrin, and can easily be converted into it by boiling with hydrochloric acid and benzene; cerebrin can also be reconverted into stearoconote.

The amount of these principles is considerable, the phosphorised and nitrogenised compounds with the cholesterin constituting 5 per cent of the brain.

The Chairman, in thanking the author, said he need not remind the Fellows that this class of investigations was of the most difficult kind, and especially the brain, which required more than ordinary boldness to attack it.

In answer to a question by Dr. Wright, Dr. Thudichum replied that the examination was conducted on normal brains from human subjects, controlled by experiments on the brains of oxen. In softening of the brain he had found free glycerophosphoric acid and fatty acids.

Mr. C. T. Kingzett then read a paper on "*Calcic Hypochlorite from Bleaching-Powder.*" After a brief summary of what was already known on the subject of bleaching-powder, the author said he had observed that needle-shaped crystals were formed in a saturated solution of bleaching-powder which had been exposed during a frosty night. On freezing a concentrated solution of bleaching-powder, breaking it up, and throwing it on a filter, the mass gradually thawed, leaving on the filter feather-like crystals. Similar crystals are obtained on evaporating a solution *in vacuo* over sulphuric acid and potash. The author has analysed these crystals, and found them to be calcium hypochlorite, a body never before isolated. The bearing of these facts on the constitution of bleaching-powder was then pointed out.

The Chairman having thanked the author,

Mr. W. Noel Hartley read a note "*On a Simple Method of Determining Iron.*" This process was originally devised as a rough and ready one in the absence of proper chemical apparatus, but has since proved to be remarkably accurate, and a good method for students beginning quantitative analyses. Equal weights of the ore to be examined and of fine iron wire (about 4 or 5 grms.) are dissolved and made up to the same bulk. A pipette full of each solution is then taken, and the ferric salt reduced to the ferrous state by warming with granulated zinc. Permanganate is used for the titration, the comparative amounts required for the pure iron and for the ore giving the percentage of iron in the latter.

The thanks of the Society having been given to Mr. Hartley for his practical and ready method of determining iron, the meeting was adjourned until Thursday, March 18th, when Dr, Hofmann will deliver the Faraday lecture at the Royal Institution "On Liebig's Contributions to Experimental Chemistry."

PHYSICAL SOCIETY.

February 27th, 1875.

Professor J. H. Gladstone, F.R.S., President, in the Chair.

Mr. Wills, F.C.S., submitted to the Society apparatus which he had devised for exhibiting the sodium spectrum to an audience. The experiment, as usually shown, consists in volatilising the metal or one of its salts between the carbon poles of a battery, and in projecting the spectrum on to a screen. The method is imperfect, as the characteristic lines of sodium are always associated with the continuous spectrum of the electric light. Mr. Wills prefers, therefore, to obtain a sodium flame by burning hydrogen which has been passed over the surface of molten metal; by this means a pure sodium spectrum may be thrown on the screen.

Professor McLeod suggested that other metals might be introduced into the hydrogen flame in a finely-divided state, and that the continuous spectrum might be eliminated by employing a horizontal slit.

Professor G. C. Foster then read a paper by himself, and Mr. J. O. Lodge "*On the Lines of Flow and Equipotential Lines in a Uniform Conducting Sheet.*" The first experimenter who worked on this subject was Kirchhoff, who used plates of copper, but owing to their small dimensions his measurements were imperfect. Quincke employed rectangular plates, and afterwards discs of lead and copper conjointly, so that he obtained a difference of potential at the junction. The next experiments were made by Professor Robertson Smith, who used conducting discs of tin-foil and deduced equipotential lines from the lines of flow. Professor Foster stated that the general mathematical theory had been fully established by Kirchhoff, who had verified it experimentally in all its main features. The object the authors of this paper had in view was to show that Kirchhoff's results can be arrived at by very simple mathematical processes, if each electrode by which electricity is supplied to or taken from the sheet be regarded as producing everywhere the same effect as it would if it were the only electrode in the sheet. The electrical condition of every point in the sheet thus appears to result from the simple superposition of the effects due to the several electrodes.

This mode of treating the question has been adopted by Professor Robertson Smith; but his paper was in the main addressed to mathematical readers. It was the aim of the authors, however, to show that the chief results could be established by elementary methods, which can be included in ordinary class teaching. The paper contained, in addition to the mathematical discussion of the subject, a description of an experimental method of laying down the equipotential lines on a conducting surface, so that the difference of potential between any two consecutive lines may be constant. Measurements were also given of the resistance of discs of tin-foil of various sizes, and with the electrodes in various positions. The results agreed closely with the calculated values, and thus supplied a verification of the theory which Kirchhoff had been unable to obtain, in consequence of the small resistance of the discs used by him.

Mr. Latimer Clark made some observations on the methods by which contact was made between the electrodes and the conducting sheet, and Professor Adams then described some of the results which he had just communicated to the Royal Society "On Lines of Force."

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PROCEEDINGS
OF THE
SOCIETY OF PUBLIC ANALYSTS.

The following discussion ensued after the reading of Dr. Stevenson's paper on the "Decomposition of Milk," read at the meeting on February 5th, 1875:—

Mr. Cleaver—I have here some results of observations on the decomposition of milk extending over the last six months. I first of all made some experiments about six months ago. I took a sample of milk, and analysed it when I bought it. I then put a dozen samples into different bottles, and sealed them up, and opened one every day and examined it. After three weeks I found the total solids had diminished from 12·48 to 11·98, but the fat in that time had scarcely altered at all; so I concluded that the whole of the decomposition was there due to the alteration of the nitrogenous matter in the milk. That milk was kept at a temperature of 70° F. for the whole time. I then thought that I would make some further experiments, extending over a longer time, with good and poor milks, and kept at different temperatures, and in stoppered and unstoppered bottles. The following are the results:—

Samples.	Time of Keeping.	Temp.	Diminution of Total Solids.
2 samples.	Dec. 8, 1874, to Jan. 15, 1875	70° F.	From 11·14 to 10·34
1 sample.	" "	"	" 11·96 " 11·12
" "	" "	55° F.	" 11·14 " 10·56

(The fat had undergone the same amount of alteration.)

1 sample.	6 weeks	55° F.	From 11·96 to 11·32
" "	Aug. 28, 1874, to Jan. 15, 1875	70° F.	" 11·92 " 9·26
" "	" "	"	" 14·00 " 10·64
" "	" "	55° F.	" 11·20 " 9·76
" "	" "	"	" 14·00 " 11·04

All these samples had been kept in closed bottles. There was a slight escape of gas when the bottles were opened, but the samples had only a slight cheesy smell, and there was no mould upon them at all. Some other samples that had been kept in open bottles formed a dense mould, and had a very bad smell. The following are some of the results:—

Samples.	Time of Keeping.	Temp.	Diminution of Total Solids.
1 sample.	4 months	70° F.	From 12·0 to 6·30
" "	2½ "	"	" 9·9 " 9·72
" "	" "	"	" 12·3 " 9·62

I think that the results of those first experiments, in which the milk was kept in closed bottles at 70° F., shows that the decomposition goes on in a tolerably regular manner, namely, at the rate of about 0·7 per month. The experiments show the same rate of decomposition ranging from three weeks to over four months. There is one thing to be noticed with regard to the diminished amount of ash. I found that there was always a deposit of mineral matter on the side of the bottle. What it was I did not examine. There was also a slight deposit which would not come off by shaking up the milk. I also tried the effect of adding sodium carbonate for the exact neutralisation of the acid in the milk; but I found that the results did not come out differently from those obtained when the milk was evaporated in an open vessel, without the addition of sodium carbonate.

Dr. Muter—I have been for some time back making experiments on this point. I have kept milk in this way for certain fixed times, and I have found that all of them, except one, underwent a loss in the month of about 0·5. There was one of them which had not lost more than $\frac{1}{50}$ths. That one milk stood apart from all the rest, and behaved differently. I ascertained what is the change that goes on. I have found, in all those milks that had lost, an increase in the weight of the material extracted, and I found that it was lactic acid which gave me the slight increase. I estimated the acid volumetrically, but I forget, for the moment, what it was; but there was no doubt that there was an increase after extraction by ether in that way.

Mr. Allen—I have had no experience in the analysis of old milk of this sort, but I found in the case of urine that it could be kept very successfully, for a long while, by adding a drop or two of carbolic acid to it. I would suggest the possibility of using the same thing in the case of milk. It is volatile, and you might be able to get it off from the residue, or if not you might add a known quantity with a certain amount of soda, as carbonate of soda, and see whether that would keep the milk.

Mr. Wanklyn—My experience on the keeping of milk is this:—Within a week there is very little alteration, even in summer; that is to say, the analytical results that you get from it will not vary much within the first week. But after the first week milk is uncertain, and my experience is that occasionally milk will keep for weeks, and will show you the same analytical results as at first, and occasionally milks will decay very much even when they are tightly corked; but after the first week I think we cannot depend upon the results. Then when milk is a day or two old it will very often be observed that the solid residue is slightly brown. This is occasioned, I believe, by a slight production of lactic acid, which chars the milk sugar; but the charring is so small that, though a colour is produced, there is no difference in the weight that we can perceive. With regard to the mode of dealing with very old milk, I once had occasion to deal with a very old milk, and I adopted the plan of taking the ash, and I took the ash of 50 c.c., and obtained perfectly normal results. I believe the only satisfactory way of dealing with very old milk, in order to answer the question of watering, is by taking the ash; and, if anything further were wanted, I should be inclined not to take the chlorine, but to determine the phosphoric acid. I think it would be worth while to make investigations in that direction, for there is a great chance of the phosphates in milk being very constant.

Dr. Redwood—The ash in genuine milk, according to my experience, varies from about 0·65, in the 100 parts by weight, to very nearly 0·8; and in one or two instances I found it to be above 0·8, and that variation—looking to the smallness of the quantity of the ash in relation to the milk itself—is rather a considerable variation, for it seems to me very difficult, by reference to the ash alone, to come to any very definite conclusion. I have had some experience in reference to milk that has been kept for some time, and I may state generally that I agree with what Mr. Cleaver has indicated this evening, that the amount of deterioration or alteration of milk greatly depends upon the temperature at which it is kept, and the extent to which it is exposed to air; and milk, if it is kept in a filled and closed vessel, at a temperature not rising above 55 or 60 degrees, undergoes very little change in the course of even three or four weeks. I have kept a great number of samples of milk for very nearly a month, in a cold place, in bottles that were well corked and sealed, and found that, upon opening them, there has been very little gas evolved, very little acidity in the milk, and very little variation in the total residue on evaporation as compared with that taken when the milk was fresh. But where the temperature is higher—for instance, in summer weather, when the temperature ranges from 70 to 80 degrees—a very material change takes place in even a shorter period.

Mr. Cleaver—I may state that I have found that, in the milk of cows that have just calved, the ash has gone up to 1 per cent, but that milk contained 28 per cent of solid, 12 per cent of which was albumen; and in several cases which I have examined, when there has been from 4 to 8 per cent of albumen, the ash has always been 0·8 or 0·9, or perhaps 1 per cent.

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Dr. Stevenson—Of course when milk becomes stinking and putrid, and has decidedly a butyric odour, it is not often that we get samples of it, because they elude us by bursting the bottles in which they are kept, in consequence of the gas evolved. In milk covered with fungous growth I have noticed the deposit on the side of the bottle, but I have not examined it, and I cannot say that it is oxalate of lime. The milk ash is of some importance. I have not noticed the wide variations which Dr. Redwood has mentioned. I agree with Mr. Wanklyn that the ash of milk follows pretty generally the caseine in it; and Mr. Cleaver's results of course show that when milks contain a high percentage of albumenoids there is a high percentage of ash, as one might expect. I cannot confirm Mr. Cleaver's experiments with regard to the rate of decomposition. He makes it almost a constant rate of progression per month, but I have found that not so. I have found the decomposition to go on more quickly in some than others, and I could not myself form a ratio. In two reference cases which have come under my notice the milk had kept with remarkable constancy. The result was that the solid matter did not vary $\frac{1}{10}$th per cent, and the amount of water came out exactly, or did not vary $\frac{1}{4}$ per cent from that which I had originally returned. In that case the milk kept from about the 21st of November to about the end of the first week in January. It was fortunately kept in a cool place, and the weather was remarkably cool, and the bottle was full and sealed. The other case occurred last winter. The milk had been kept about a month. The result of my analysis almost exactly confirmed the original analysis of Prof. Attfield, but in that case there was not the slightest putrescent odour in the milk. I find that when you get a cheesy, or butyric, or putrid odour the results are unreliable.

The following paper was read by Mr. G. W. Wigner at a meeting of the National Association for the Promotion of Social Science, March 10th, 1875 :—

ADULTERATION AND ADULTERATION ACTS, WITH SPECIAL REFERENCE TO THE "SALE OF FOOD AND DRUGS ACT, 1875."*

The introduction of the Bill now before Parliament has been the occasion of my submitting to your notice the following remarks; but, to make them intelligible, it is necessary that I should refer shortly to the older adulterations and to the older Acts. I may premise that, by the term "adulteration," than which no word that I know of has been found more difficult to define, I understand, for the purposes of this paper, the various methods which at different periods have been resorted to, for sophisticating, reducing, or debasing the quality or the value of articles of diet. Some people may be supposed to imagine, from the amount of discussion which has of late years taken place on the subject, that "adulteration" is more or less a new thing—that it came in with the introduction of railways, or was caused by the first Reform Bill, or the Repeal of the Corn Laws. It is, however, a plant of no such mushroom growth. It flourished in the days of our remote ancestors; it withstood revolutions, and survived changes of dynasty; and it may be, that when Lord Macaulay's irrepressible New Zealander shall have completed his artistic studies, he may have to betake himself from the "broken arch of London Bridge," to the same task as that which occupies Mr. Sclater-Booth to-day. We find that, in the days of the Henry's, the Charles's, and the George's; as in the days of Victoria, the much derided "wisdom of our forefathers" had to be devoted to the framing of measures for the same object as that to which the attention of our present legislators is directed. It seems to me that the object and the scope of any Act for the repression of adulteration should be to protect the public health and the public pocket; in short, to contrive that the consumer is supplied with a wholesome article and gets fair value for his money. These two points, I conceive, cover the whole ground. Amongst the earliest Acts for the repression of adulteration, we find that in the time of Henry III. a law was passed, forbidding the sale to His Majesty's subjects of unwholesome wine and meat. In the reign of Charles II., the subject of the adulteration of wine was again dealt with, and in that of George IV., a very stringent Act for the prevention of the adulteration of bread was passed, it being enacted that any person using alum, "or any preparation or mixture in which alum shall be an ingredient," in the manufacture of bread, should be subject to a fine of not more than £20, or in default to a term of imprisonment, varying from three to twelve months. By this Act power was also given to certain officials to enter the premises of any baker, to search for, and if found, to seize any bread so adulterated, or the ingredients, presumably intended to be used for such adulteration, the baker in whose premises such articles were found being subjected to the same penalties as those I have just mentioned. Another clause also provided for the punishment of any person obstructing or hindering such officers in the execution of the duty just pointed out. These clauses were certainly as stringent as any to which the most "harassed" trade in our time, even that of the publican, has been subjected. We find that from time to time various Acts were passed for the prevention of the adulteration of tea, beer, coffee, cocoa, &c., and it may be mentioned as a curious fact that, in an Act of 1777, it was made punishable with a fine of five pounds, to "mix," "colour," or "stain" tea, and that this exact phraseology is reproduced in the Act of 1875. No attempt, however, was made to grapple with the subject as a whole till the year 1860, when the first general Adulteration Act was passed. This was led up to or brought about mainly as the outcome of the *Lancet* Commission, of which Dr. Hassall was the chief, and the results of that gentleman's extensive examination of the quality of the various articles of food and drink usually sold, were astounding. Dr. Hassall found, *inter alia*, that tea was all but universally adulterated, and that, with such various foreign substances, as "lie tea," "exhausted leaves," "starch," Prussian blue," China clay," "turmeric," &c. He found that it was next to impossible to obtain either a pure loaf of bread or a pure pint of milk, the former being adulterated with alum, and the latter "let down" with water. Of 49 samples of bread taken consecutively, not a single one was pure and at least half the samples of milk were watered, the diluent in some cases being to the extent of 50 per cent. More than 80 per cent of the coffee was adulterated, the debasing materials used being beans, mangel wurzel, chicory, acorns, and other adulterants "too numerous to mention." Pepper was mixed with wheat, mustard, rice, linseed, &c. Chicory, itself an adulterant extensively used, was sometimes rendered still further objectionable by the admixture of burnt and powdered carrot. Cocoa having first been depreciated by the addition of flour or starch, had its original colour reproduced by the help of sundry earthy colouring matters. Not a single sample of pickles was found to be uncontaminated with copper, and even ground spices were reduced in quality by the addition of flour, sago, and arrowroot. Of course, considering that Dr. Hassall's researches extended to *all* articles of diet it was only to be expected that he would meet with some to adulterate which was either impossible, very difficult, or unprofitable; but taking the many hundreds of samples which he analysed in the aggregate, including those grossly adulterated, slightly adulterated, and those more or less pure, it was found that something like 63 per cent were adulterated, the fair presumption being that amongst the *poorer* classes, such a thing as purity in the articles of their daily consumption was all but unknown. Mr. Wanklyn made the analysis of milk his speciality, and of 56 samples taken from the London Workhouses, he only found 6 that were pure. He also examined many hundreds of samples of milk in different parts of the country, and though I regret that I have not the actual figures before me, I may mention that he found

adulteration to be the rule and purity the exception; and as a proof of the correctness of his results, it may be noted that though he published the names and addresses of all the delinquents, he had not to defend a single action for libel, though I believe one was threatened. After these disclosures the Act of 1860 was passed, and undoubtedly was productive of some alleviation to the poisoned and cheated consumer, but this was chiefly from its *deterrent* influence; for, from its defective machinery, only three or four analysts were appointed, but very few prosecutions were instituted, and as far as I can ascertain only about 300 samples were analysed in all. The Act became, therefore, virtually a dead letter, and for twelve years the adulterators had it pretty much their own way. They became more expert at their work, and from time to time devised improved methods of "committing the oldest crimes the newest kind of ways;" and when at length, in 1872, when the evil had become too glaring, and the public patience again gave way, they resented with virtuous indignation any interference with their time-honoured "usages of trade," and immediately that the last Bill was passed, they discovered that they were the victims of oppression and injustice. That this Act has been productive of much good is evidenced by the outcry which the tradesmen have made against it. It is noticeable that, in the majority of cases of "hardship," "oppression," &c., the defence has *not* been that a man was punished for selling, as impure, an article that was really pure, but that he bought it in the same condition as he sold it; and this is a point which I contend should never be admitted as a sufficient excuse. The object of an Adulteration Act is, or ought to be, to protect the *public*. The wholesale and the retail dealer should be left to make what arrangements they please between themselves, but the *public* should not suffer; and if a shopkeeper is so ignorant as not to know whether he is selling adulterated or unadulterated articles, the sooner he selects some humbler occupation which he does understand the better. But the tradesmen, after these many years of immunity, had "waxed fat," and become a great power in the country. They had their advocates in the press, and their representatives in Parliament, and with a dogged determination worthy of a better cause they resolved to "die hard." They protested that adulteration was in itself a good thing; that their fathers and their grandfathers had practised it, and that they were all "most respectable men." They maintained that they knew better than their customers did what their customers really wanted; that when a man asked for "tea" he would be disappointed if he did not have it heavily "faced;" that if he asked for "coffee" it was only his ignorance which prompted him to use such a word, for what he really required was a totally different substance, known to the "trade" as chicory; that when he asked for "mustard" he didn't *mean* mustard, but a mixture in about equal quantities of mustard and flour, delicately tinted with turmeric; that bread, *minus* alum, was unsightly if not unwholesome, and that undiluted milk was not suitable to the English palate. As to the gentlemen who had accepted appointments as "public analysts," they mocked at their science and derided their ability, and this to such good effect that it became the exception to find the word "analyst" in some newspapers, without the flattering prefix of "incompetent." The upshot of this long and loud "cry of the oppressed" was the appointment of the Select Committee which sat last year. Of this Committee I would speak with the utmost respect, composed as it was of honourable and high-minded gentlemen, and if it was tinctured with a leaning to the side of the tradesmen rather than to that of the public, perhaps the same objection might be made to the composition of the House of Commons itself. This Committee applied itself to its task with admirable industry. They heard the opinions of numerous tradesmen, and the evidence of two or three analysts, and ultimately they issued a report, in which they admitted that they had come to the conclusion that the Act of 1872 had "done much good," but at the same time they considered that there had been some cases of hardship, and so they thought some alteration in the law should be made. They had not, however, before them any tabulated or authentic returns of the actual results of the working of the Act, but these results I have (acting on behalf of the Society of Public Analysts), within the last few days got together and collated, and they are as follow:—Returns have been received from 60 districts, showing, during an average period of 16 months, the number of samples analysed and the proportion found to be adulterated:—

Total number of samples analysed.. .. 14383
Total number found to be adulterated .. 3774

Being about 26 per cent of the whole. Of the 3774 adulterated, 1066 were samples of milk. A comparison of these figures, with the results which I have already quoted of Dr. Hassall's investigations some years ago, clearly demonstrate that a striking improvement has taken place in the quality of the articles of general consumption. As a pendant to the foregoing table, I will trouble you with a word or two as to my own experience as a public analyst for three of the largest metropolitan districts. I have examined within eighteen months upwards of 700 samples of articles of food and drink, of which 84, or *rather less than 12 per cent, were found to be adulterated*; but if I averaged the samples submitted to me during the last six months, the proportion of adulterated ones would be very much reduced. For instance, a little more than a year ago, almost every sample of bread I examined was adulterated with alum in greater or less proportions. For some months past I have not found a trace of alum in any bread I have examined; of 16 consecutive samples of milk taken in 1873, 14 were either skimmed or watered; of 13 samples recently taken from the same district, only 2 were adulterated. The Committee having made the report, with which no doubt you are familiar, it was evident that further legislation was contemplated, but the Government having only recently acceded to office, and having many other matters on their hands, postponed bringing in a Bill until this session, in order that the measure might be a comprehensive and well matured one. The Bill is now before us, and it is only a mild criticism to say that it does not strike the reader as being characterised by any particular signs, either of deep meditation or of profound acquaintance with the subject with which it deals. In considering the "Sale of Food and Drugs Act, 1875," I wish it to be most distinctly understood that I give the Government credit for the most beneficent intentions, but as this is a matter about which we cannot afford to take "the will for the deed," I will endeavour to point out fairly, and with as much clearness as I can, the defects of the proposed measure.

Clause 1 repeals all previous enactments, from which we are to understand that the present Bill is complete in itself.

Clause 2 restricts the Act to England, though the previous Acts included Scotland and Ireland in their operation; but as there would appear to be some confusion in the mind of the Government itself as to whether or not this is really intended, I pass this clause by without further comment.

Clause 3 defines the meaning of *food* as "Every article eaten or drunk other than drugs." This is all very well as far as it goes, but I think it lacks exactness, as it might be argued that certain substances, such as tea and coffee, are, in their natural state, neither "eaten" nor "drunk." "Any article of food or drink," or "Any article used for the purpose of food or drink," would, I think, be preferable; or if we could condescend to go to our Colonies for a definition, I think we might advantageously copy one which occurs in an Adulteration Act passed by the Canadian Parliament last year. It runs thus:—

"*Food* means and includes every article used as food in the state in which it is offered for sale, or that is

used in the preparation of food by admixture therewith, either before, during, or after cooking."

"*Drink* means and includes any liquid used as a beverage, and any article used in or for the preparation or partial preparation of any beverage."

I will now read Clauses 4, 6, 7, 8, and I must ask the meeting to follow me closely. [Read clauses.] Now I will undertake to prove, from the clauses I have just read, that under this Act any possible means of adulteration may be practised with impunity. Clause 4 says—"No person shall knowingly mix, colour, &c., any article, &c., with any ingredient of *a nature* injurious to health." First of all, this clause does not mean what it says. It clearly means that the penalty shall be incurred for "*rendering an article* as sold *injurious to health*," as there are innumerable substances used, and fairly used, in the manufacture of articles of food which, if eaten or drunk by themselves, would be not only "injurious to health," but actually poisonous; take, for instance, yeast in bread, and essence of bitter almonds in confectionery. However, leaving this and taking the evident meaning of the clause, we come to this word "*knowingly*," which also occurs in Clauses 5, 6, and 9. A man must add these forbidden ingredients *knowing* them to be injurious to health; but how if he doesn't know or professes not to know? or, if he does know, how is his knowledge of their effects to be proved? "Ignorance" will certainly be "bliss," for whenever action is taken against a man he has only to plead that he *didn't know any better*. Surely this is setting a premium on ignorance, and the intelligent and honest trader will stand at a great disadvantage as against his ignorant or unscrupulous brother. Clause 6 says that a man shall not "knowingly sell any article not of the nature, substance, and quality of the article demanded;" but here again he has only got to stick to ignorance, and he is safe. Suppose he admits that he does know,—that when he has been asked for one article he has supplied another,—he still runs a very small risk of being punished, for he can plead that the adulterant has been added for the purpose of rendering the article "palatable," or of "improving its appearance;" and what is palatable and what is pretty being purely matters of opinion, the vendor will have a right to urge that his is of as much value as that of the opposite side,—and the addition of alum to bread does certainly improve its appearance. But, as if this poor innocent tradesman were not sufficiently guarded from the possibility of a conviction, he is allowed also to urge that the adulterated article is mixed "in accordance with the usage of trade." This is exemplifying the maxim that "whatever is, is right" with a vengeance. He has only got to show that his neighbours are as guilty as himself to prove that he is not guilty at all. If it is the practice in a certain district (as it has been in some districts) to add 50 per cent of water to milk, this "usage of trade" is to receive legislative approval. He can also successfully plead several other "exceptions," but it is hardly worth mentioning them, as, if those I have alluded to are allowed to stand, it matters little what is added to them; but I may mention that, under the first exception of Clause 6, salt or carbonate of soda might be added to milk, to the injury of young and delicate children. But if, by any extraordinary perversion of justice, or if, because the trader is too ignorant to avail himself of any of these "exceptions" so kindly provided for him, he should run the risk of being convicted, Clause 8 steps in, and takes care of him. It says, in effect, "So long as you do not poison your customers, in case we have not made the 'exceptions' elastic enough for you, you are hereby authorised to adulterate your wares with *whatever* substances and to *whatever* extent you think fit, if you take care to affix or hand the purchaser a label stating that the article is 'mixed'—the sort of label, the size of the type, and whether to be fixed inside or outside of the parcel, and all such little matters, being left to your own discretion." The intention of this clause is, I am free to admit, very praiseworthy, and I think that if it were enacted that the label should be printed in distinct and legible type, and that it should bear the minimum proportion of the substance under the name of which the article was sold, it might work well: for instance, it should not be allowable for a man to sell simply "a mixture of chicory and coffee," but the label should state that "This is sold as a mixture of chicory and coffee, and contains more than (so much) per cent of coffee," so that the purchaser may know whether he is buying 25 per cent of chicory and 75 per cent of coffee, or *vice versa*. In the sixth exception under Clause 6 it is enacted that a drug may be sold not "of the nature, substance, and quality," of that asked if sold according "to the usage of trade." As it is manifestly extremely desirable that drugs should be sold in a pure state, it would be much better to say "or in accordance with the standard laid down by the British Pharmacopœia, or by approved works of Materia Medica." In Clause 9 it is made punishable to "abstract from an article of food any part of it so as to affect injuriously its quality, substance, or nature," or to sell an article from which such abstraction has been made; but in both cases this inevitable word "knowingly" creeps in, and nullifies what would otherwise be a very good clause.

Clause 10 is a very long one, but I have only one remark to make about it. It enumerates various local authorities, and says they "*may*" appoint Analysts. Now, for an Adulteration Act to be effective, its application should be universal, and I can see no just reason why—without unduly burdening the smaller districts, which might easily be grouped—the most obscure, as well as the largest, places should not have the benefit of having their articles of diet examined. It would be well, also, if it were made imperative that the Analyst should examine quarterly some minimum number of samples, which number could be fixed at so many per thousand of the inhabitants.

After having had to criticise this Bill so far adversely, it is pleasant to find something to approve of, and in Clause 13 I think it is a very wise provision to empower Medical Officers of Health to procure samples for analysis, seeing that they have peculiar opportunities for observing the evil effects of the consumption of adulterated viands, and for judging as to the likelihood or otherwise of certain substances being adulterated.

In Clause 14 I have only one fault to find, but it is a serious one. The Inspectors appointed to purchase samples for analysis are, of course, paid a salary for the execution of such duty, and of course pay for such samples out of public money, and it has always hitherto been part of their duty—after having duly purchased such samples—to take them at once to the Analyst for the district, but this clause says they shall only do so "if they deem it right to have the article analysed." I think the absurdity of leaving any option to the Inspectors must be obvious. Take an extreme case. You might have in a district an able and willing Analyst anxious to do his duty, a Local Authority also anxious that the Act should be fully put into operation, two or three paid Inspectors, told off for the express purpose of purchasing samples, and yet, if they "deemed it right," these Inspectors might, after going through all the ceremony of purchasing, paying for, sealing, and dividing a number of samples, dispose of them in any way they "deemed right;" and in spite of all the organised machinery for having articles analysed, the Analyst might never have a sample brought to him at all.

Clause 16 provides that when the Analyst resides more than two miles from the place where the samples are purchased, a personal delivery of them by the Inspector may be dispensed with, but the only other means of conveyance is to be by sending them through the post-office as registered letters. A difficulty I see about this is, that I have frequently had say half-a-dozen quartern loaves of bread brought to me in one day, and I am in doubt whether

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the Postmaster-General would be willing to convey them as "registered letters."

Clause 17 provides that if a vendor refuses to supply an Inspector with a sample of any goods which he exposes for sale, on having the value of such sample tendered to him, he shall be liable to be fined £5 for such refusal. To this clause I have no exception to take. I think it is a perfectly fair and reasonable one.

Clause 22 deals with cases where defendants challenge the correctness of the analysis, and request that a second one may be made, and it enacts that a magistrate may refer the sample to "the Analyst of an *adjoining* district, who shall analyse it as if he were applied to by any officer in his district." For "adjoining" I would substitute "another," so as not to unduly curtail the magistrate's choice; and there would certainly be no justice in an Analyst being compelled to analyse a *strange* sample "as if he were applied to by any officer in his own district," as this would really be to analyse it for nothing, or next to nothing, he being "in his own district" paid by a salary, and if by any fees for individual samples, such fees being only in addition to his salary. With the alteration and excision I have mentioned this clause would, I think, be practicable.

Clause 25 seeks to protect the retail tradesman from being deceived by the wholesale dealer from whom he buys, and says that if he can produce a "warranty" from the latter he shall be acquitted. The intention of this is admirable, but there is a large loophole. The retailer goes free on production of a warranty of the purity of an article which has been found to be adulterated, but no provision whatever is made for touching the wholesale man who gave the false warranty. Unless this be altered, so that in cases of the sale of adulterated articles the law may lay hold of somebody, it is not difficult to foresee that there will be a great number of warranties soon afloat, and it is equally clear that, except for the purpose of furthering adulteration, they will not be worth the paper on which they are written.

In Clause 20, I think it should be ordered that, in the case of a second offence, proceedings against the offender should be compulsory. As a schedule to this Act is printed a curious and cumbrous form of certificate for analysts to use, but it is so utterly impracticable that I must suppose it to have been drawn by some gentleman who was totally unacquainted alike with the requirements and the possibilities of the range of an analyst's certificate. There are numerous other points in this Bill to which I might have adverted, but they will doubtless be touched upon by the speakers who will follow me. I shall, I think, have made it sufficiently apparent that, in my opinion, the Bill, as it stands in its entirety, is a retrograde bill, and if passed would tend to the encouragement, not to the repression, of adulteration. It has occurred to me and to some other people that it would have been much simpler to have simply made it punishable to sell "an adulterated article," giving a definition of what should be considered an "adulterated article," with certain limits as to the *maximum* or the *minimum* quantity of certain constituents which different articles might contain. Such a "definition" and such "limits" have after considerable study been drawn up by the "Society of Public Analysts." In conclusion I can only express the confident belief that, whether this Bill be so altered and amended as to become a useful measure or not, our discussion of the subject of "Adulteration of Food" here to-night, cannot but be of great value in drawing the attention of the public to a question which most nearly and vitally affects the good of the community.

A discussion followed, in which Mr. Holborn, Mr. Sewell White, Dr. Muter, Mr. Helm, Dr. Bartlett, Dr. Dupré, and others took part. The question brought forward related mainly to the difficulties which had been found to arise before magistrates in deciding between conflicting analytical testimony. One or two speakers treated the Bill from a trade point of view, dwelling on the hardship to smal tradesmen, which they believed had sometimes arisen during the working of the Act at present in operation.

The subject of the nomination of a supreme court of appeal for disputed cases of analysis was also freely discussed; one gentleman arguing that such a body or institution should, to insure impartiality, be appointed without consultation of persons holding appointments under the Act; and others that the Society of Public Analysts itself should have a prominent voice in the matter.

Decided opinions were expressed against the appointment of medical officers of health as Public Analysts, on the ground that the successful pursuit of food examination required more time than such officers were enabled to devote to its practice, consistently with a proper performance of their other important duties.

The correctness of a so-called classification of evidence compiled and issued in the interests of the Tea trade, having been impugned by Dr. Bartlett, Mr. Holborn, who announced himself as a joint author of the work in question, spoke to its absolute accuracy, which was, however, disputed by Mr. Wigner.

Votes of thanks to the Chairman and to Mr. Wigner concluded the meeting.

CORRESPONDENCE.

CHAMELEON BAROMETER.

To the Editor of the Chemical News.

SIR.—In my first communication upon this subject (see CHEMICAL NEWS, vol. xxxi., p. 88) I stated that the actual temperature had apparently no effect upon the colour of the paper. Since then I have had reason to change my opinion. During the late severe weather I have had better opportunities of studying the behaviour during frost, and I have observed that, though the paper will remain red in summer for a difference of 3° between the thermometers, in very cold weather it is only red when that difference sinks to 0°, or perhaps 0·5°. This seems to agree with the fact that cold air cannot dissolve so much aqueous vapour as warm air.—I am, &c.,

A. PERCY SMITH.

Rugby, March 6, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 5, February 1, 1875.

M. Becquerel has presented to the Academy a copy of his recent work "On Physico-Chemical Forces, and on their Intervention in Natural Phenomena." In this work he gives a historical summary of his researches on the development of electricity by chemical action.

On Magnetism.—M. J. M. Gaugain.—M. Elias, in *Poggendorff's Annalen*, lxii., p. 249, refers to a process of magnetisation which consists in heating a bar of iron to redness, suspending it from a pole of an electro-magnet, and letting it cool in that position. "This method," he continues, "as everyone knows, is without results." The author has tried this process, and considers that in certain cases it proves successful.

Magnetic Anomaly of Sesquioxide of Iron, Prepared from Meteoric Iron.—L. Smith.—Hydrated artificial sesquioxide of iron, dried at a high temperature,

is slightly attracted by the magnet, but loses this property if heated to redness, or beyond. Sesquioxide of iron, prepared in the ordinary manner from a solution of meteoric iron, and dried at a low temperature, behaves like ordinary oxide, with this difference—that it becomes decidely magnetic on being heated from 400° to redness. Sesquioxide of ordinary iron, mixed with nickel or cobalt, or with both, manifests magnetic properties identical with those of ordinary iron. Sesquioxide of iron prepared from meteoric iron, entirely free from traces of nickel or cobalt, behaves with the magnet like the ordinary sesquioxide. Sesquioxide produced from a solution of iron mixed with copper behaves like oxide prepared from meteoric iron. Sesquioxide of iron, mixed with manganese, gold, platinum, zinc, or cadmium does not differ in its magnetic reactions from pure iron.

Artificial Reproduction of Monazite and Xenotime.—M. F. Radominski.

Pulverisation of Manures, and on the Best Means of Increasing the Fertility of Soils.—M. Menier.—The author recommends the use of manures in impalpable powder.

On Magnetism.—M. A. Tréve.—Referring to the discovery of De la Rive, that if in Ruhmkorff's great electro-magnet the current is closed between the two poles there is neither spark nor sound, but on opening it there is a detonation almost like a pistol shot, the author states that the phenomenon announced by De la Rive is equally produced in the sphere of attraction of either pole; that it is not inherent in an inductor current alone, but that the current of any independent battery, interrupted in this sphere of attraction, gives rise to the same effects, and that the extra current augments the tension really and considerably.

On Hydrogenised Iron.—M. L. Cailletet.—On decomposing with the battery a solution of neutral chloride of iron mixed with sal-ammoniac, we obtain at the negative pole metallic iron in the form of mamillary masses, brilliant, brittle, and hard enough to scratch glass. This iron, after being washed, disengages, either under water or any other liquid, bubbles of a gas, which is pure hydrogen. In the air the iron only loses a part of the hydrogen which it contains. A specimen weighing 0·9 grm. kept for fifteen days in an open tube gave, when heated, 18 c.c. of gas, or more than half of what it contained at the moment of its preparation. If a fragment of the iron is placed under a test-tube filled with water heated to 60° or 70°, the escape of gas becomes tumultuous. 1 volume of iron contains from 248 to 235 volumes of gas. If a piece of hydrogenised iron is approached to a burning body, the disengaged hydrogen burns, and the metal is surrounded with a light flame, like that of a match steeped in alcohol. When iron has lost its hydrogen by heat, it cannot be resumed. If we use as the negative electrode of a voltameter a plate of galvanic iron previously heated, the hydrogen of the decomposed water escapes in abundance along the metal, but not any of it is taken up. Galvanic iron may be readily powdered, but after being heated it re-assumes a certain degree of ductility. Hydrogen when associated with iron imparts to it a considerable coercitive force.

Molecular Equilibrium of Solutions of Chrome Alum.—M. Lecoq de Boisbaudran.—A controversial reply to the paper of M. Gernez (*Comptes Rendus*, p. 1332, December 7, 1874).

Perbromide of Bromated Acetylen.—M. E. Bourgoin.—Already noticed.

Amelioration of the Quality of Beet-Root.—M. Ch. Violette.—The author recommends attempts to improve the beet-root by the careful selection of seed.

Special Butyric Fermentation.—P. Schützenberger.—If at a temperature of 20° to 30°, the direct rays of the sun being excluded, stems of *Elodea Canadensis* are left in a solution of sugar, after the lapse of a few hours a part of the sugar is inverted, a mixture of hydrogen and carbonic acid is given off, and butyric acid is formed in notable quantities.

Second Note on the Combustion of Detonating Mixtures.—M. Neyreneuf.—The author finds that if detonating gaseous mixtures are exploded in test-tubes, previously coated with paraffin, definite figures are traced in the fatty matter.

Les Mondes, Revue Hebdomadaire des Sciences. No. 5, February 4, 1875.

New Arrangement for Producing the Electric Light.—M. Wilde.—A Mr. Ladyguine has overcome all the difficulties encountered in the production of the electric light, and has rendered its general use practicable. It has long been known that the carbon electric light is not due to a direct luminous effect of the electric current, but merely to the property which this current possesses of heating the conductors which it traverses, and that with the greater intensity the more resistance they oppose to its passage. The intensity of the ordinary electric light (with carbon points) arises from the circumstance that the stratum of air, a bad conductor, which is found between the two charcoal points, is heated to an excessive degree by the passage of the electric current, and thus produces indirectly the combustion of the coke or charcoal electrodes, heated to whiteness. It has also long been known that solid bodies may also be heated to whiteness without the presence of gaseous matter. Thus, slender platinum wires have often been heated by the current. The light from this source is more fixed and constant than that of the luminous arc between the carbon points; but it is too feeble and too costly, whilst attempts to increase its intensity generally result in the fusion of the platinum. M. Ladyguine replaces the wire by slender rods of carbon (coke) hermetically sealed in a glass receiver, from which the oxygen has been removed.

Electro-Magnet with Concentric Tubes.—M. Camacho.—The principle of the apparatus is that of tubular magnets. A central iron tube is surrounded with a helix of copper wire furnished with an insulating coating. Around it is another iron tube with its helix, and then a third, likewise with a helix. The effect is said to be beyond all comparison greater than that of any previously devised arrangement.

Photographic Properties of the Salts of Vanadium.—M. J. Gibbons finds that a sheet of paper steeped in a solution of a vanadic salt, and dried, gives, on exposure to the light, a good image under the influence of uranic salts.

Experiments on the Effects of Magnetism upon an Electric Discharge passing through a Rarefied Gas in the direction of the Produced Axis of the Magnet.—MM A. de la Rive and E. Sarasin.—Not adapted for abstraction.

Electric Discharge in the Aurora Borealis, and the Spectrum of the same Phenomenon.—M. Selim Menström.—The pale lights seen over the summits of the mountains of Spitzbergen and Lapland are of the same nature as the aurora. Similar phenomena observed in other regions prove that electric discharges of the same nature as the aurora may occur elsewhere besides in the arctic regions. The spectroscope is the safest means of determining the nature of these phenomena in doubtful cases. In the spectrum of the aurora there are nine rays, which probably agree with the lines given by the component gases of the atmosphere. The spectrum of the aurora may be resolved into three different types.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 14, February, 1875.

Reproduction, by Chemical Methods, of Useful Natural Organic Substances.—M. de Luynes.—A lecture on the recent artificial production of alizarin, vanillin, &c.

Report on the Improvements Recently Effected by Private Industry in the Manufacture of Porcelain: Present State of the Manufacture in Limoges.—M. Salvetat.—A lengthy paper; not suitable for abstraction.

Reimann's Farber Zeitung, No. 2, 1875.

This number contains a continuation of the essay on the removal of "burls" from woollen goods.

A Hungarian professor has "discovered" the extraction of indigo from wood—a process far from uncommon in Thüringen during the great blockade of the Continent at the outset of the present century.

Dr. E. Jacobsen has invented a kind of pencils or crayons made of methyl-violet, thickened with gum, and fixed in a wooden case. The writing appears like that of a lead pencil, but when moistened becomes a bright violet, and will yield a perfect press-copy, even when several months old.

There are receipts for a crimson, a chamois, a ponceau, and a blue on knitting-yarns; a rose for silks; a dark blue for half-woollen doubles; a "pott-green" for cotton; and a silver-grey for mixed garments.

Aniline Black.—To prevent aniline black, fixed by printing, from subsequently turning green, R. Glanzmann proposes to fix previously prepared aniline black upon the fibre by means of albumen. He recommends the following proportions:—100 grms. aniline, 400 grms. of bichromate of potash, and 2 kilos. of water. Boil for three hours, wash by decantation, drain on a filter till the moist mass weighs 300 grms.

M. Reimann points out that he introduced a similar procedure four years ago (see No. 7, 1871).

No. 3, 1875.

This number contains a paper, issued by the Berlin dyers, on the decay of the tinctorial arts in that city, which was formerly supreme in woollen yarns.

There is a continuation of the essay on the removal of "burls" by chemical means; a receipt for dyeing cloth a Russian green, and for chrome-orange on cotton yarns.

MISCELLANEOUS.

The Faraday Lecture.—We have pleasure in announcing that the Fellows of the Chemical Society will dine together on Friday, the 19th inst., being the day following that on which the Faraday Lecture will be delivered by Professor A. W. Hofmann, who will be the guest of the Fellows on that occasion. The charge for tickets will be one guinea.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in desilvering lead. Joseph Alexander Cicognani, merchant, Great Winchester Street, London. (A communication from Baron Andrea Podesta, Genoa, Italy.) May 21, 1874.—No. 1800.—In this Provisional Specification the process of desilvering lead is divided into seven stages:—1. Melting the lead in pots and skimming. 2. Introducing zinc into the pot and skimming off the argentiferous zinc. 3. Heating the desilvered lead in a reverberatory furnace to remove the remaining zinc. 4. Roasting the zinc scum on the inclined sole of a furnace to allow some of the lead to run out. 5. Treating the zinc scum to transfer its silver to a comparatively small quantity of lead. 6. Cupelling the rich lead of stage 5. 7. Treating the slag produced in stage 5.

An improved process for preparing hydrate of magnesia. William Edward Newton, civil engineer, Chancery Lane, Middlesex. (A communication from Charles H. Phillips, New York, U.S.A.) May 21, 1874.—No. 1810. The object of this invention is to produce an improved medicinal compound, consisting of a hydrate of magnesia, which the inventor denominates "milk of magnesia." This is effected by causing a solution of ammonia to act on and decompose any suitable soluble salt or compound of magnesia, so as to precipitate all the magnesia in the form of a hydrate.

Improvements in treating bones, horn-piths, phosphates, and other materials in order to obtain products therefrom, and in the apparatus or means employed therefor. Andrew George Hunter, Flint, North Wales. May 21, 1874.—No. 1811. The features of novelty which constitute this invention are—First. The system of recovering hydrochloric acid from solutions containing phosphates or phosphoric acid by evaporation or condensation. Second. The use of vertical or other retorts provided with valves, whereby continuous distillation of phosphorus, charging and discharging may be carried on without permitting access of air to the interior of the retorts when at work. Third. Causing volatilised phosphoric acid to come in intimate contact with carbon at a temperature sufficiently high as to deoxidise the acid. Fourth. The use of gelatinous silica for the purposes described. Fifth. The production of gelatinous silica and phosphate of soda or potash from silicates of soda or potash by precipitation by means of phosphoric acid. Sixth. Separating phosphorus from phosphate of soda or potash by distilling the said phosphates mixed with silica, and recovering silicate of soda or potash available for producing gelatinous silica. Seventh. The combined process whereby the constituents of bones or horn-piths may be obtained as glue or gelatine, fertilisers, sulphate of lime, and phosphorus. Eighth. The combined process of decomposing phosphate of lime, soda, or potash, and of the subsequent recovery of the said soda or potash. Ninth. The employment of precipitated tribasic phosphate of lime for the production of phosphorus by distillation with silica. Tenth. The employment of self-acting valves between the distilling retorts and condensers to prevent back pressure or back flow therefrom to the retorts. Eleventh. The employment of self-acting valves between the several retorts to prevent back pressure or back flow from one retort to the other, and to enable one retort of a series to be opened at pleasure, without back flow from the others.

Improved means or method of clarifying sewage and impure waters from dye-works, bleach-works, tanneries, mills, and manufactories, and rendering the precipitate or "sludge" combustible and useful as fuel. Rupert Goodall, machinery agent, Armley, Leeds, York. May 23, 1874.—No. 1826. This consists, first, in the employment of certain chemicals to precipitate the solid matter; secondly, in the employment of lime and chemicals; and, thirdly, in the employment of the chemical precipitants, lime, and small coal, to render the precipitate available for fuel.

A new or improved indelible ink. John Garrett Tongue, of the firm of Tongue and Birkbeck, patent agents and engineers, Southampton Buildings, Chancery Lane, Middlesex. (A communication from Pierre Auguste Gaffard, manufacturing chemist, Paris.) May 25, 1874.—No. 1839. This invention relates to the manufacture of a new indelible ink. The process employed to obtain this ink is very simple. It consists of diluting well separated carbon with a solution of an alkaline silicate, such as silicate of potash, soda, or other silicate. The following are the proportions of materials, which in practice may vary according to the nature of the agents employed, the invention not being confined to the said proportions:—Carbon or lamp-black from wax candles, lamps, or other source, 1 part by weight; silicate of potash (of a syrupy consistency), 12 parts by weight; ammoniacal liquid, 1 part by weight; distilled water, 38 parts by weight.

NOTES AND QUERIES.

Glue and Size.—I shall be obliged if you can inform me whether there is a good work published on glue- and size-making from bones, and where I can obtain it.—William R. Earp.

Ultramarine.—You would greatly oblige me by giving me a list of the English ultramarine manufacturers, or by giving me advice where I could get such a list.—A. O.

Welding Iron.—Having had occasion to melt some white metal over our smith's fire this morning in a wrought-iron ladle, it was afterwards found impossible for him to weld two pieces of wrought-iron together, heated in the same fire to a welding heat (though there was none of the metal let fall into the fire), for after being beat together into their proper form they broke across in the place of welding, showing a black oxidised surface; and when looked at with a small lens it was found that they had not joined together in one single place, though the iron was an inch square. Now, Sir, I should feel very much obliged if either you or any of the correspondents of the Chemical News could give me the reason or *rationale* of such an occurrence. If lead or zinc is melted over his (the smith's) fire, the same occurrence takes place, and before he can go on with his work he has always to take away the old fire, and make a new one.—Henry Leeming.

MEETINGS FOR THE WEEK.

Saturday, March 13th.—Physical, 3.
Monday, 15th.—Medical, 8.
—— London Institution, 5.
Tuesday 16th.—Civil Engineers, 8.
—— Zoological, 8.30.
—— Royal Institution, 3. Alfred H. Garrod, Esq., "On Animal Locomotion."
Wednesday, 17th.—Meteorological, 7.
—— Society of Arts, 8.
Thursday, 18th.—Royal, 8.30.
—— Royal Institution, 3. Professor Tyndall, "On Subjects Connected with Electricity."
—— Philosophical Club, 6.
—— Chemical, 8.
Friday, 19th.—Royal Institution, 8. Weekly Evening Meeting. Dr. R. Liebreich, "On the Real and Ideal in Portraiture." 9.
—— Philosophical, 8.
Saturday 20th.—Royal Institution, 3. Prof. W. K. Clifford, "On the General Features of the History of Science."

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THE CHEMICAL NEWS.

Vol. XXXI. No. 799.

ON SOME REACTIONS OF METALLIC SODIUM ON CHLOROFORM.

By SERGIUS KERN, St. Petersburg.

The following is the result of my researches on some interesting reactions of sodium and chloroform. The chloroform for the experiments was prepared by heating $CCl_3.CO.OH$ (trichloracetic acid) according to the following equation:—$CCl_3.CO.OH = CCl_3H + CO_2$.

1. In a strong test-tube 1 grm. of chloroform and a small quantity of water were poured, whereupon 3 grms. of metallic sodium were then added. A strong reaction with sparks and fire was the result, and all the interior part of the tube was covered with finely divided charcoal; in the lower part, meanwhile, a white substance was received, which proved to be a mixture of sodium chloride (NaCl) and caustic soda (HNaO). The reaction which took place was accompanied by the evolution of hydric chloride (HCl), and may be represented:—

$$CHCl_3 + 3Na + H_2O = 2NaCl + NaHO + HCl + C + H.$$

It must be mentioned here that this experiment must be made very carefully, because from the high temperature of the reaction the tube often breaks.

2. Some chloroform and metallic sodium were left for brown precipitate was received, which was dried over six or seven days in a loosely corked test-tube. A light sulphuric acid under a glass bell. The brown semi-crystalline powder obtained is whitened on exposure to the action of air. The analysis proved it to be a sodium salt of formic acid ($NaCHO_2$), which gave with sulphuric acid free formic acid ($HCHO_2$).

The reaction is a very complicated one which I am now studying. I presume that the metallic sodium firstly is transformed into caustic soda by the oxygen of the air, and acts in this state on chloroform; the final reaction must be represented by the following equation:—

$$CHCl_3 + 4Na + O_2 = CNaHO_2 + 3NaCl.$$

LECTURES ON THE MORPHOLOGY OF CRYSTALS AT THE CHEMICAL SOCIETY.

By NEVIL STORY MASKELYNE, M.A., F.R.S., &c.

(Continued from page 112).

Lecture XI.

The descriptions of the forms of the tetragonal system was succeeded by a discussion, on the part of the lecturer, of a law to which only slight allusion had been hitherto made, which regulates certain defalcations in the number of the faces of a form that are occasionally presented by crystals. Planes of symmetry have been alluded to as potential, but not necessarily actual planes of symmetry, and the scrutiny of crystalline forms has led to the result that in such crystals the presence of some and the absence of other faces of a form may be traced to planes that in a complete form would be planes of symmetry, having this symmetrical character, as it were, in abeyance; and, further, that this is the case invariably in a similar way with regard to conformable planes of symmetry. Such partially developed forms Mr. Maskelyne designated as mero-symmetrical forms.

They are of two distinct kinds, similar, however, in this respect—that the extant faces represent one half the absent faces, the other half of those belonging to the complete form, and that they are absent or extant in alternation. The extant faces may all belong to different normals—that is to say, each normal of the form may be represented by one extant face, or the extant faces may be those belonging to one-half of the normals, each alternate normal thus presenting its pair of parallel faces on the crystal, the remaining normals being obliterated; and, further, a kind of mero-symmetry occurs, in which the crystal presents but one quarter of the faces of a form, as where alternate normals only are extant, and each of these only carrying a single face.

The varieties of mero-symmetry that a crystal may present will obviously be in some cases very numerous, but they are readily classified, and symbols found for them, when the particular planes of symmetry that remain such in a crystal are recognised, and when we know whether the crystal is centro-symmetrical or not. One variety of mero-symmetry which presents some interest from the physical point of view is that known as hemimorphism, in which a single plane of symmetry unique in its kind ceases to be symmetrical, while the form also is not symmetrical to a centre, all the faces on one side of this plane being, therefore, absent.

The lecturer proceeded to sketch the character of the mero-symmetrical forms of the three systems already considered, viz., the clino-rhombic, the ortho-rhombic, and the tetragonal systems of crystallography.

ON THE MANUFACTURE OF CAUSTIC SODA.*

By JOHN MORRISON, F.C.S.

(Continued from page 104.)

And now for manufacturing details. No special proportion of slack is usually adopted for the making of the black-ash from which caustic soda is to be manufactured. 3 cwts. salt cake, with a shovelful or two of fished salts, are first laid down in front of the mixing-bed door, then a quantity of lime mud (which varies from time to time to keep pace with its production) say on an average 4 cwts., and finally a proportion of slack, more or less, according to quality, but usually about 1¼ cwts. In a convenient corner a supply of limestone is from time to time thrown down, and from this the mixer throws on to the top of the charge when in the furnace as much as experience proves will ensure with proper working a satisfactory ball.

Balling with limestone is less laborious than in the case of chalk, the latter being the most refractory, and more work is consequently got out per furnace in Lancashire than here. Fourteen to sixteen balls per twelve hours' shift is the usual produce, when as above a proportion of lime mud is substituted for an equivalent amount of "stones;" but if the latter alone be used, this margin can be considerably increased. Thirty-four balls are then a good double shift's work, though there are plenty of men in Lancashire who have drawn twenty, and some who have turned out twenty-four respectable balls in a single shift.

Lancashire balls are not nearly so regular in appearance as those produced in this district, and are, I think, also a little less easily lixiviable.

It is quite as desirable that the vat liquors going to the causticiser should be settled as those going to the salting down pan, and though in many works this department receives very little attention, owing to a current belief that in the operation pan the lime will carry down with it everything that previous settling could possibly have removed, I am strongly of opinion that good settling before each of the three stages of causticising, evaporating, and finishing, is the *sine qua non* of irreproachable caustic.

After settling comes causticising. The vat liquor is reduced to 16-18° T. with water heated to or near the boiling-point, and treated gradually with

* A Paper read before the Newcastle-upon-Tyne, Chemical Society

reshly burnt lime, which is thrown into an iron cage or basket of any suitable form, fixed within the vessel—with the object of retaining all stones—while the liquor is maintained in a state of brisk agitation. The experienced workman can tell with a considerable degree of accuracy, by the boil, colour, and other indications, when the liquor is thoroughly causticised; and the operation is complete when no effervescence is produced on the addition to a filtered sample of the batch of a few drops of dilute sulphuric or hydrochloric acid. The charge may be run off at once to a separate settling vessel, or may be settled in the operation pan. In the latter case the carbonate lime subsides in the course of half an hour sufficiently to admit of commencing the withdrawal—by means of a drop or swivel pipe—of the clear supernatant liquor into a well, whence it is removed to the causticised liquor settlers. When as much liquor as possible has been drawn off, a fresh quantity of vat liquor and water is run in for the completion of a second batch (which, I may remark, does not take quite as much lime as the former), and when this one has in its turn been removed, the agitator is re-started, and a quantity of water run into the pan, and the whole being mixed and sludged off on to the filtering bed, the pan is ready for another charge.

As soon as the filter has received a batch, the vacuum pump is set in motion, and first the air and then—as rapidly as it collects—the filtrate is withdrawn from underneath the bed. Very soon cracks appear on the surface of the mud. These are immediately obliterated with a wooden rake, while a supply of water is run on and worked well into the mud, with the object of removing as much soda as possible. But in three or four hours the magma has become very firm, and as much of the liquor removed as could be induced to leave it, so that the vacuum pump may be stopped, and the liquor which is now in the receiving vessel, be run into the operation pan to assist in the reduction of the vat liquor to the causticising strength.

In the settlers the causticised liquor deposits any little lime it may have previously retained, and when perfectly "bright" may be removed as required to the weak pans. Two of these, as I have explained, are attached to each black-ash furnace, the back one being a little higher than its neighbour. Into the former, which serves as a feeder to the other, the liquor is transferred from the settlers, and though in it only a state of incipient ebullition is usually attained, still by increasing the amount of effective work performed by its companion, it is of material service. In the front weak pans the liquor attains a strength of 35° to 40° T. cold, and from them the strong pans are replenished by means of a 2 or 3 inch pipe screwed on to the outer end of the front weak pans, and the free end of which—provided with a cock—projects over the side of the back strong pans. The latter, as in the case of the back weak pans, serve as feeders to their less fortunate brethren who have the lion's share of the duties. In them so furiously indeed does the liquor boil that "splash boards" are necessary. These are commonly of sheet iron (about nine inches deep), passing right round, and clasping the pan flanges by means of several brackets rivetted to them for the purpose.

A constant stream runs into these pans regulated to keep up the supply as rapidly as the evaporation proceeds, and when a sp. gr. denoted by about 60° T. hot is arrived at, a few pounds of nitre are in some works added, with the object of keeping the pan free from scale and aiding—as the workmen suppose—in the deposition of the "salts." It of course also assists in the oxidation of the sulphides. The evaporation is continued till the liquor reaches 70° to 72° T. if for 60 per cent caustic, or 80° to 85° if for 70 per cent; and then the fires are allowed to burn down, and the pans consequently to cool. After the lapse of an hour or two the supernatant liquor is drawn off through a swivel pipe into shallow settlers, and the salts remaining on the pan bottom extracted and placed on a small drainer (fixed conveniently for the purpose) by means of a perforated shovel, and when the liquor has thoroughly drained from them they are removed for use in the black-ash furnaces. The strong pans are run off about once in twenty-four to thirty hours, and about five of them are necessary to make up one ten-ton pot of finished caustic soda. In the settlers which feed the pots, where we must now suppose the liquor, a small additional quantity of "salts" is deposited, but only sufficient to necessitate a weekly or fortnightly cleansing. The deposit from them, however, is of a sloppy and undrainable character, and contains sulphides. In some works these pot settlers are dispensed with, but when comparative immunity from carbonate is an object, they are absolutely essential. When they are not in use, of course more settling time must be allowed the strong pans—say six or eight hours.

The pots on receiving a sufficient supply of liquor from their settlers are immediately fired, and any remaining "salts" which may separate until the liquor reaches about 90° T. are re-dissolved as the latter becomes more concentrated. The pots are used for finishing in rotation, and into the one selected for this operation fresh supplies of liquor from one or more adjoining pots, and of a strength ranging from 120° to 150° T., are transferred by baling.

But it just occurs to me that I have omitted to remark, what, however, has been probably evident to most of you, that the several levels from that of the causticised liquor settlers downwards to the caustic pots are so arranged that the liquor can be advanced from stage to stage by ordinary gravitation. Where this arrangement throughout is impossible, partial recourse must be had to hand-baling, which is a tedious and slovenly operation.

The liquor from the pot settlers boils freely at about 250° F., throwing off a semi-transparent straw-coloured foam, which deposits in the eddies—in little island-like masses or tufts—a light and loose froth. This froth consists of "salts," principally carbonate of soda, and is removed by means of a perforated skimmer if the production of 70 per cent caustic soda be the object, but allowed to take care of itself if that of 60 per cent is the intention. At this early stage, the evolution of ammonia—chiefly the effect of the addition of nitre to the boat pan batches—becomes very distinctly perceptible, and with the exhaustion only of the reagent does the characteristic odour vanish. A quantity of "salts," too, separate until the liquor approaches the sp. gr. represented by 85° to 90° T., about which strength, however, they begin to grow gelatinous, and soon re-dissolve entirely. But occasionally when a high-strengthed and pure caustic is required, these salts are removed, the pot being of course cooled down, and the liquor settled to admit of this. And now the liquor which has become deeper in colour, boils at about 300° F., and commences to discharge a black looking scum containing much sulphide; and gradually, as it becomes more concentrated, it assumes a more viscous or treacly condition, while if it be bad or technically "sulphury" it begins to exhibit strong objections to remaining within bounds, so that the men have to whip or flip the surface in a peculiar manner with a fishing shovel to keep down the foam as it is termed. If, however, you are not looking, they will, to save a little of this trouble, pour in a libation of oil from a convenient "feeder," or failing that, impart a dose of furnace grease. When the batch is in this perverse condition it also ill brooks the addition of fresh liquor, especially if weak and unsettled, so that great caution and long suffering are very necessary on the part of the workmen to prevent its elopement. It will submit to be coaxed, but resolutely declines being driven; and when very evilly disposed, strong measures are extremely dangerous, and must be undertaken in the full consciousness of the risk of its suddenly, and without troubling you with any preliminary warning, bolting out of the pot with something akin to explosive violence; a performance better viewed from a distance, but best witnessed not at all, for it produces an awful mess, and

renders you nervous for the rest of the day. When this "sulphury" liquor is very strong the foam is much more sluggish than at earlier stages, and from it separates a scummy sort of crust, or perhaps more correctly a crusty kind of scum, which readily adheres to any tool brought into contact with it, and collects abundantly around the sides of the pot. The administration of homœopathic doses of nitre, sprinkled over the surface is the plan adopted to "cut away" this excrescence, and restore the liquor to its pristine state; but this stupid condition is a great nuisance while it lasts, for it renders gentle firing absolutely necessary, so that the completion of the batch is delayed. When it reaches 400° F. the liquor is extremely concentrated, thick and dark, and has almost ceased to boil or give off steam; what little steam is evolved now, however, carries with it fine particles of caustic soda, which cause unpleasant irritation to exposed portions of the skin. The sensations are similar in kind to what would ensue on brushing one's cheeks with a bunch of rather vigorous nettles, but they are *facile princeps* in degree. The pots though, do not all "bite" with equal severity, and the condition of the atmosphere would almost seem to have something to do with the business, for it is in damp foggy weather that the sensations are most exasperating. At a temperature of 500° F. the "boil" has resolved itself into a gentle effervescent-like motion, extending round the edges of the pot. And now small quantities of a pungent irritating fume are emitted, with carbonaceous matter, while a reddish deposit or "sublime" forms round the pot rim, containing sulphide and some carbonate. Finally the boil ceases altogether, and floating on the surface of the batch a black-looking froth, intermixed with a number of more solid-looking particles, commends itself to your notice. To call this a scum would be almost too calumnious, for when a little is taken on a scoop, and closely examined, it really presents a very respectable appearance, exhibiting the metallic lustre of graphite in a finely divided condition. At this stage the pot is covered with a sheet iron lid provided with a small opening at one side, and the fire being simultaneously urged as strongly as possible, a portion of the graphite slowly consumes. When the temperature is sufficiently elevated, a point the workmen easily ascertain by experience, two courses are open for the complete oxidation of the sulphides—one consisting in the introduction of nitre, the other in that of the current of atmospheric air. In the former case, the nitre is introduced (a hand-scoopful at a time) through the opening. Its action is at first very energetic, and if the pot be very hot, it deflagrates as soon as it touches the surface of the batch, flooding the latter with a fine brisk effervescence, which quickly subsides, and permits of a further addition of the reagent. At the commencement, the nitre may be introduced pretty rapidly, but as the pot approaches "clearness," fresh additions must be made with extreme caution, for fear of overdoing; and to this end it is necessary, every now and then, to solidify a small sample by pouring over a clean shovel, and to apply to it a drop or two of solution of acetate lead; and when the film of caustic presents, after such an application, just a faint darkening by transmitted light, sufficient nitre has been added, for, as the workmen express it, the fire will "clear the rest." In the case of oxidation by a current of air, the latter is generated by an ordinary blowing engine with short stroke for low pressure; and it is very essential, particularly when water is the lubricant adopted for the air cylinder, that the latter be provided with a receiver, to which may be attached the safety-valve, for the complete interception of the water which would otherwise pass into the pot, with obvious consequences. The engine usually adopted in Lancashire is double acting, and if for blowing not more than two or three pots at once, has a 12-inch air cylinder and a 12-inch stroke. The main delivery pipe may be 2½ inches, and is provided with a reducing tee branch for each pot, and a waste cock. When a pot is ready for blowing, a strong 1¼ inch wrought-iron pipe, terminating at its lower end in a perforated ring of about 18 inches in diameter, or occasionally in a tee of about the same length, is plunged into it till the ring or tee rests on the bottom; and the upper end, to which an india-rubber pipe fitted with a coupling screw is secured, is then attached to one of the branches of the air pipe. The only precaution necessary on now starting the engine is to remove any stray water from the pipes by opening the waste cock for a few seconds, and on closing it, communication may be immediately opened with the pot. The fused mass is soon in violent commotion, its temperature gradually rising till, after the lapse of two or three hours, it reaches redness. If the liquor has been good, and the boat-pans nitred, three or four hours' blowing will be sufficient; but if no nitre has been employed in the pans, about eight hours will be requisite. In the case, however, of inferior liquor, resulting from bad black-ash or careless lixiviation, the operation may occupy a much longer time, cases having occurred when thirty-six hours' blowing have been necessary. The same cautions as to over-doing apply to blowing as in the case of nitreing. Occasionally the pots become clear quite suddenly, and from this cause, but more frequently from the negligence of the men, they are "over-done," and rendered green. In this case the usual course is to throw in a small piece of sulphur, which brings the batch once more into condition; or the same result may be secured by the cautious introduction of a scoopful or two of liquor from a neighbouring pot.

(To be continued).

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 12, 1875.

R. Angus Smith, Ph.D., F.R.S., &c., Vice-President, in the Chair.

E. W. Binney, F.R.S., V.P., said that at the present time great attention was being paid to the sewerage of towns. Our Corporation had brought before the public a plan for dealing with the flood waters of the Medlock, and it is generally understood that Parliament will attempt to do something to prevent the further fouling of streams. Both Parliament and Corporate bodies have been long in moving in this matter, and the doing of that which should have been done 30 years ago will now be a matter of the greatest difficulty. In 1840 the Irwell approached Salford in so pure state that numerous fish were seen in its waters near the present Peel Park, but after Manchester and Salford sewers had entered it none were to be met with in it at Cornbrook. Fish were also at that time in the Medlock above Pin Mill Bridge.

In order to show how long a time authorities take to consider before they trouble themselves with action he brought a Report on the Streams of Manchester, published by Dr. Lyon Playfair in the Health of Towns Commission in 1844. After describing the geology, watersheddings, and streams of the district, the report proceeds as follows:—"When the boroughs of Manchester and Salford were not so thickly populated as at present and the surface of the soil was in its primeval condition, without any irregularities arising from artificial excavations, since caused by the making of bricks and for other economical purposes, the sites of the towns, from their undulating surfaces alone, would possess good top drainage into the streams and rivulets before mentioned. Some little obstruction to the drainage might arise from the rows of cottages which are generally built nearly at right angles to the inclinations of the surface of the land; still the irregularities produced by the hand of man have doubtless been in part rectified by public sewering into the water-courses above

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alluded to, and had such water-courses been allowed to pass unimpeded through the towns, although they might have caused some nuisances, still they would not be in anything like the filthy condition which they are now, owing to the weirs and dams marked X in map appended to this report that stop their courses and form so many cesspools, allowing some of the top waters certainly to flow along but collecting all the heavier particles, and thus continually generating the most offensive effluvia.

"The River Irwell, after having by its tributaries afforded drainage and sewage to the towns of Bolton, Heywood, Bury, Rochdale, Radcliffe, and numerous other places, and having been pent up in countless reservoirs and dams for manufacturing purposes, approaches Salford by the Adelphi in a pretty tolerable condition as to purity, inasmuch as small fish live in its waters—a very rare circumstance in any other of the streams hereinafter mentioned. At the Adelphi is a high weir built quite across the river. After passing this impediment the stream is polluted by numerous works upon its banks and the contents of the sewers of the eastern and south-eastern parts of Salford, until it receives the waters of the Irk at Hunt's Bank in a much worse condition than its own—in fact, as filthy as water can well be; thence the river flows sluggishly along the western part of Manchester to Hulme, where it receives a portion of the waters of the Medlock and Shooter's Brook (a part of this being kept in the Bridgewater Canal) charged with the contents of the sewers of the eastern and southern parts of Manchester; it is then stopped at Throstle Nest by a dam across its stream. For many miles in its course towards Runcorn it emits offensive smells, and bubbles of light carburetted hydrogen gas rise to its surface.

"The Irk approaches Manchester from Blackley. It, like the Irwell, is anything but a pure stream to begin with. After being dammed up at Messrs. Appleton's paper mills, Mr. Hartley's dye works, Mrs. Crompton's paper mill, and Messrs. Appleton's upper logwood mills, it joins the Moston Brook at Collyhurst. This last-named brook is impeded in its course within a quarter of a mile of its junction by three weirs, namely, at Messrs. Appleton's St. George's logwood mills, Messrs. Dentith and Co.'s chemical works, and a weir not far from the old Rochdale Road at Collyhurst. Proceeding with the Irk:—This river after its junction with the Moston Brook is dammed up at Messrs. Appleton's lower logwood mills and near the Bull's Head Inn in Newtown; and after receiving the refuse from the numerous dyeworks, size manufactories, chemical works, tanneries, skinyards, gas-works, sewers, &c., it is stopped at Messrs. Caistor and Thompson's corn mill at Scotland Bridge and the School Mills in Long Millgate before it reaches the Irwell at Hunt's Bank.

"The Medlock enters the borough at Beswick charged with the refuse of numerous works, and is dammed up by weirs across its course at Messrs. Guest's weir at Beswick, Neck Break weir, the Island Mill weir (a little below which near Fairfield Street it receives some fetid water from a small dam at Cruickshank's Mill), Messrs. Hoyle's weirs in Ardwick, and the weir near Messrs. Wood and Westhead's Mill in Garratt. At this place it receives the water of Shooter's Brook, a filthy little stream as black as ink, which enters Bradford from Newton, and after flowing under Butler Street to New Islington exposed is covered in till it reaches the Medlock at Garratt. This last-named stream, after its junction with Shooter's Brook, passes under Oxford Road along Little Ireland, and is dammed up near Messrs. Birley's Mill in Kenyon Street. It then receives many sewers from the surrounding district and the river Tib in Gaythorn, which runs under the centre of Manchester but is entirely built over, and reaches the Duke of Bridgewater's Canal in as polluted a state as possible; thence some of its water after being employed as a power of winding goods escapes into its old course, which joins the Irwell near Hulme Hall. The waters of the Duke of Bridgewater's Canal are chiefly derived from the Medlock after it has received the contents of the Manchester sewers, and thus are in as bad a condition as the streams before described.

"Cornbrook enters Ardwick from Gorton, and partly open and partly built over traverses Ardwick, Chorlton-upon-Medlock, Greenheys, Hulme, and Cornbrook, at which last mentioned place it reaches the Irwell in as polluted a state as any of the other streams.

"Besides the streams before described I may mention a little rivulet near Stock Street in Cheetham, which crosses York Street, and after forming several stagnant ponds enters the reservoir in Strangeways Park. There is also another rivulet, which crosses the New Bury Road at Stocks, and flows down to the pool near Strangeways Hall. A third goes from Cheetwood by the end of Broughton Lane; and a fourth by Broughton Grove. All these run into the Irwell. There is also a filthy and stagnant pool of water in front of the houses at Stony Knolls, which excites very little attention among the inhabitants. In Pendleton there is a small stream which, though it has often been presented at the court leets as a nuisance, and is correctly designated "The Black Ditch," remains in just as bad a condition as it ever did. In all the streams above described a number of dead dogs and cats are to be seen in the various states of decomposition, bubbles of gas, light carburetted hydrogen, rise up to the surface, and, although offensive smells are met with at all times, they are by far the most annoying when the barometer has experienced a sudden depression after having been high for a considerable time previously. Sulphuretted hydrogen is the gas which chiefly causes the odour, though doubtless phosphuretted hydrogen assists in some measure."

Such was the condition of the Manchester streams prior to 1844. Immediately after the publication of the Health of Towns Commissioners' Report the sewerage of towns and villages was increased to a great extent, and in nearly all cases the refuse matter was conveyed into the neighbouring streams instead of being utilised in manuring the land as it had been previously employed. No doubt sanitary engineers have been the chief offenders in polluting our waters during the last 30 years, but manufacturers have also done their share by disposing of their refuse matter into the streams. The consequence is that not only are the waters more polluted, but their beds are being continually raised. Single towns on the banks of streams have little power to alter matters, there are so many vested interests to be dealt with. Numerous owners of property have by law what is called a right to foul waters by long user, and it will require strong parliamentary powers to effect any good. The owners of the numerous weirs will have to be compensated prior to such obstructions being removed and allowing the waters of the streams to flow and cut their courses as they once did. Before any great engineering works in the making of tunnels are attempted it is only reasonable that the streams should have a fair chance to cleanse themselves by their own natural flow of water. Manchester and Salford could try what the removal of the weirs at Douglas Mill, the Adelphi, and Throstle Nest would do. Surely such a simple experiment is worth trying before hundreds of thousands of pounds are spent in forming tunnels.

However, let Manchester and Salford spend what money they may, little good will be done unless the pollution of the waters above from their sources downwards to those towns is stopped. No doubt those towns set a bad example in the beginning, but as all the places on the streams are more or less guilty, they ought all to make a fair start together in the race of amending their evil ways of fouling streams and wasting manure.

If once the fœcal matter of a large town is diluted with water it is very costly to get it back again either by evaporation or sewage farming. Rival patentees advertise and recommend their respective plans as most efficacious, but at the present time he was not aware of the whole of the sewage waters of any large town in England having been profitably applied for farming purposes.

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PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

"SALE OF FOOD AND DRUGS BILL, 1875."

In returning to the subject of this Bill, which has just been reprinted, we have much pleasure in congratulating our readers on the improved form in which it now appears, and we venture, at the same time, modestly to congratulate ourselves upon the removal of the greater part of the blemishes to which we were the first to direct the attention of the Government and the public, and which we have been constant, in season and out of season, in protesting against.

We may mention a few of the defects which have been remedied, and a few of the blots which have been eliminated.

The operation of the Act is now to be extended to Ireland and Scotland.

The definition of the word "food" is now amended in accordance with our suggestion, and instead of "Every article eaten or drunk" it now reads "Every article used for food or drink," thus meeting the hypothetical argument that certain substances in their unprepared state are neither "eaten nor drunk."

Clause 5 (which was Clause 6 in the Draft Bill) is now rendered operative by the excision of the pernicious word "knowingly," and instead of "No person shall *knowingly* sell any article . . . which is not of the nature, substance, and quality of the article demanded," it now stands—"No person shall sell, to the prejudice of the purchaser, any article," &c. The significance and importance of this alteration will be obvious to all who have given any attention to the subject.

The "exceptions" under this clause are reduced in number, and though we confess we still view one of them with some suspicion, it is impossible to over-estimate the importance of the omission of the one which would have rendered "the usage of trade" a justification of adulteration.

In Clause 6 the words "knowingly" and "usage of trade" are alike conspicuous by their absence, the clause simply running—"No person shall sell any compound article of food which is not composed of ingredients in accordance with the demand of the purchaser, under a penalty of twenty pounds."

Clause 7, which refers to "labelling," is rendered clearer by the provision that the label shall be "*distinctly* and *legibly* written or printed."

In Clause 9, which forbids the abstraction "of any part of an article so as to affect injuriously its quality," &c., the word "knowingly" is also struck out.

In Clause 11 an injustice which would have been perpetrated in compelling an Analyst to examine a sample from a district other than his own, without any payment beyond the fee fixed by the local authorities, is corrected; and if a purchaser in one district takes a sample to the Analyst of another district, the payment for such analysis is to be in accordance with the arrangement made between the two parties to the contract.

In Clause 21, by the adoption of our suggestion to substitute the word "another" for "adjoining," the choice of a magistrate, in a case of reference, is not to be arbitrarily confined to any Analyst in his immediate locality.

Clause 26 is very greatly amended, and now goes far to meet what would have been one of the chief difficulties to be encountered by persons having to put the Act in force. We have before pointed out that though the retailer was to be allowed to go free on production of a written warranty of the purity of the article which he was prosecuted for selling, no provision was made for touching the wholesale dealer signing such warranty. It is now provided that "Every person who shall give a false warranty in writing . . . shall be liable to a penalty of twenty pounds," and "Any person who shall apply to an article of food . . . a certificate or warranty given in relation to any other article" shall be subject to a like penalty.

It will be seen that these alterations will go far to render the measure a practicable and useful one, and as—when this Bill first saw the light—we felt it our duty to speak of it with almost utter condemnation, it is now with peculiar pleasure that we do justice to the successful endeavours which its authors have made for its improvement. Having said thus much in favour of the Bill as it now stands, we must just say a word or two on some points which appear still capable of improvement.

In the interest of the tradesmen the wording of Clause 3 should be slightly modified. It says that a person shall be punished for "mixing, colouring, staining, or powdering any article of food, with any ingredient of a nature injurious to health." This surely means if the article in its entirety is rendered by such admixture injurious to health, or else a tradesman might be fined for using in the preparation of confectionery minute quantities of flavouring matter, which though certainly if eaten by themselves injurious, and perhaps poisonous, yet in the proportions in which they are used are perfectly innocuous.

By Clause 9 we regret to see that the appointment of Analysts is still to be left optional. We feel strongly the importance of making such appointments compulsory, and we trust that the wisdom of Parliament may even yet correct this defect.

We have already insisted that when an Inspector, employed for the express purpose of purchasing samples for analysis, with money supplied to him for that purpose, shall have so purchased such samples, he should, as a matter of course, take them forthwith to the Analyst; but for some occult reason, which we are unable to fathom, it is still left to him either to take them or otherwise dispose of them, "as he deems it right." We think the absurdity of this only requires to be distinctly pointed out to the House to get it remedied.

We notice that the same extraordinary form of certificate is reprinted with this last edition of the Bill; but this is a matter of detail, and we feel little doubt as to its being arranged satisfactorily.

It remains for us now to await the result of the debate in Committee; but the Government having conceded so much already, we cannot but feel sanguine as to their further action, and it may be that we shall best exert our strength in carefully watching and combatting any reactionary amendments introduced for "trade" purposes, rather than in attempting to exact the concession of *every* point we may deem important, for after all—as we have before reminded our readers—we shall have another opportunity of offering our advice and co-operation when the Bill reaches the "serener atmosphere" of the House of Lords.

The fourth paper read at the meeting on February 5, 1875, was by A. Dupré, Ph.D., Lecturer on Chemistry at the Westminster Hospital:—

NOTE ON THE NATURAL CONSTITUENTS OF WINE.

Before we can decide whether or no any given article is adulterated, we must necessarily be acquainted with the composition of the article in its pure state. This appears so obvious a truism, that it might seem unnecessary even to mention it, and yet it is one grievously sinned against by many. There is, perhaps, no article of large consumption on which ignorance is so general as it is in relation to wine. Many illustrations of this might easily be brought forward. Wine is the fermented juice of the grape, with such additions only as are essential to the stability or keeping quality of the wine. Such a definition, while it will admit, as unadulterated, the fortified wines of Spain, Portugal, and other southern countries, excludes wines from Germany, France, Hungary, &c., if similarly fortified. In the first case, the addition of a certain

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amount of spirit is essential to the stability of the wine, in the second it is not. We may accordingly divide wines into two classes; *natural wines*, the strength of which has not been increased by the addition of spirit and *fortified wines*, the strength of which has been raised by such addition. Some so-called liqueur wines and champagnes might, perhaps, with propriety, be placed into a third class, as being more strictly manufactured than other wines. For our purposes, wine may be regarded as an aqueous solution or mixture of various alcohols, acids, compound ethers, sugar, mineral substances, and so-called extractives, with traces of tannin, essential and other oils, albumenoid substances, and colouring matter.

Alcohols.—Natural wines, as met with in commerce, generally contain from 6 to 12 per cent of absolute ethylic alcohol by weight (7·5 to 14·6 by volume) in volume; in some very rare cases the strength may perhaps come up to 13 per cent (15·8 per cent by volume). With less than 6 per cent a wine is scarcely drinkable, and more than 13 per cent cannot be contained in a natural wine. First, because grape juice rarely contains the requisite amount of sugar for the production of more alcohol; secondly, because such an amount represses, if it does not altogether stop, fermentation; this will to some extent depend on the temperature, and if such fermentation is not then put a stop to altogether, the wine would become vinegar. In fortified or brandied wines, the alcoholic strength of course depends entirely on the operator: it usually ranges from 12 to 22 per cent by weight in volume. Besides this ethylic alcohol, wines always contain traces of some of the higher homologous alcohols, as propylic, butylic, amylic, &c., alcohol. Indeed, the flavour and bouquet of a wine greatly depends on the presence of these alcohols, and they are also perhaps of great influence on its physiological effects. In large brandy distilleries these alcohols are, in a measure, separated from the ethylic alcohol, and constitute the wine fusel oil.

Acids.—All wines contain a greater or less proportion of free acid, and possess therefore an acid reaction. These acids may be conveniently divided into two classes, namely, non-volatile acids, or such as remain in the residue when the wine is evaporated on a water-bath; and volatile acids, or such as are driven off during evaporation. The acids of the first-class, except the trace of succinic acid, are derived from the grape juice, but they are generally present in the wine in a different proportion to that in which they were contained in the must. The chief acids of this class are malic acid and tartaric acid (sometimes part of the tartaric acid is replaced by racemic acid), the former predominating even in pure natural wines, and predominating largely in all fortified wines, in plastered wines often even to the total exclusion of tartaric acid. The volatile acids, and the succinic acid, have all been formed during or after fermentation. In small quantity they are indispensable, being chiefly instrumental in the production of flavour, smell, and bouquet. When present in larger quantity they are, however, objectionable, and give evidence of maltreatment of the wine. The principal of these acids is acetic acid; there are, however, always found small quantities of other homologous acids of this series, as formic acid, propionic acid, butyric acid, &c. In good sound wines the amount of free acid, calculating as if the whole of it consisted of tartaric acid, ranges from 0·3 to 0·6 per cent by weight in volume. In white natural wines not more than about one-fourth of the total acidity should be due to volatile acids. In red wines, as well as in fortified wines, the proportion of volatile acids is usually higher, but should not, even in these, amount to more than about one-third of the total acidity.

Aldehyds.—Many Greek wines contain an appreciable amount of ordinary acet-aldehyd, the same wine being usually characterised by a very high proportion of volatile acid. Besides, in Greek wines, I have met with aldehyd in one sample only of Sauternes and in one of Rhine wine. In both instances the bottles of wine had purposely been placed for nearly a year, upright and badly corked, in an ordinary sitting room. From this it would appear that the presence of acet-aldehyd in a wine must be looked upon as a decided mark of unsoundness. Although, then, acet-aldehyd is the only one of the series which has been proved to be present in wine, it is not improbable that part of the bouquet of wine is due to the presence of some of the higher members of the series.

Compound Ethers—Whenever we have a mixture of alcohols and acids, compound ethers begin to be formed. The amount of alcohol ultimately converted into compound ethers depends upon the relative proportions of alcohols, acids, and water present in the mixture. It should be distinctly understood that the amount of alcohol or alcohols finally converted into compound ethers, expressed in its equivalent of ethylic alcohol, is independent of the nature of the alcohols and acids present, and depends solely on the relative proportion of alcohols, acids, and water present. If, on the other hand, we add an excess of any compound ether to a wine, this will at once begin to be decomposed, until, ultimately, the wine will contain no more than it would otherwise have reached in the natural order of things. Berthelot has given a formula, by means of which this proportion can be calculated, and we have thus, in these compound ethers, a most valuable means to judge of the genuine character, age, &c., &c., of a wine. In young wines the amount should fall below the calculated proportion, in old wines it should correspond with it. The compound ethers, like the acids, may be divided into volatile and non-volatile. To the former class the smell and bouquet of a wine are chiefly due; the latter have but little influence on the character of a wine. Pure natural wines contain, according to my experience, invariably a greater proportion of volatile than fixed ethers. The same is the case with some fortified wine, as Sherry and Madeira. Fortified wines, on the other hand, except those just mentioned, generally contain a greater proportion of fixed ethers. The total amount of compound ethers contained in a wine is extremely small. Thus, taking the highest proportion I have as yet met with (in a Madeira fifty years in bottle) the alcohol present in the compound ethers amounted to 1 part in 800 parts of wine equivalent, roughly speaking, to about 1 part of compound ether in 300 parts of wines.

Sugar.—Grape juice contains two kinds of sugar in equal proportions, namely, grape sugar and fruit sugar. It would appear, however, that during fermentation more grape than fruit sugar is decomposed as a rule, so that the sugar remaining in the wine consists chiefly of fruit, or left-handed sugar. Roughly speaking, I have found it to consist of about 1 part of grape to 3 of fruit sugar. If any inspissated must or cane sugar has been added to the wine, the proportion of grape sugar found increases. Any cane sugar added is speedily converted, by the action of the acids of the wine, into invert sugar, a mixture of grape and fruit sugars, identical with that found in grape juice. Thus champagne, which is sweetened by the addition of cane sugar, contains almost pure invert sugar, or 1 part of grape to 1 of fruit sugar, the change being accomplished in less than four weeks. Should any grape, potato, or starch sugar have been added, the proportion of this sugar may of course rise still higher, and may even exceed the fruit sugar in amount. Pure natural wines, when more than a few years old, contain, as a rule, but little sugar; very rarely as much as 1 per cent., and generally very much less. Young wines of this class not unfrequently, however, retain as much as from 2 to 6 per cent. Fortified wines, in which the fermentation has been stopped by addition of spirit, or to which concentrated must has been added, frequently contain up to 5 per cent. of sugar, and in some liqueur wines the sugar rises even to 25 per cent. Champagnes usually contain from 4 to 10 per cent.

Glycerine and Succinic Acid.—Both these are produced from sugar during fermentation. According to Pasteur, 107 parts of cane sugar, or 112·8 parts of grape suga

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yield about 3·6 of glycerine and 0·6 parts of succinic acid. In a natural wine, the glycerine should thus amount to about $\frac{1}{12}$ part of the alcohol present.

Albumenoid Substances.—White wines, properly fermented, are almost free from albumenoid matters, they having been decomposed or precipitated during or soon after fermentation. Red wines, and most fortified or imperfectly fermented wines, contain, when young, an appreciable amount of albumenoid matters. In the course of time, however, the greater part is thrown down with the colouring matter and tannin.

Colouring Matter.—In so-called white wines the colour should, strictly, be due to the oxidation products of tannin. The colour generally takes years for its development, and rarely becomes very dark. The public, however, do not like a very pale wine, and, accordingly, more or less colouration is imparted to the wine by the addition of a little caramel. The colour of wine to which concentrated must has been added is of course due, in great measure, to the same cause. Red wines owe their colour to the presence of a blue colouring matter, which, during fermentation, is extracted from the husks of the grapes, and is turned red by the acids of the wine, the grape juice itself being in most cases colourless. Little is known, as yet, regarding the exact nature of this blue colouring matter of wine, but the subject is one which well deserves, and would no doubt repay, careful investigation.

Mineral Substances or Ash.—All wines when they are evaporated, and the residue left is incinerated, leave a greater or less proportion of ash. The nature and proportion of ash left by a wine is one of its most characteristic features. Speaking generally, the total amount of ash left by pure natural wines ranges between 0·15 and 0·25 per cent. Under normal conditions this ash consists of carbonate, sulphate, phosphate, and chloride of potassium, chloride of sodium, phosphate and carbonate of calcium, with traces of magnesia, iron, silica, and frequently lithium and manganese. The carbonates are not, of course, present as such in the wine, but are produced during incineration. If the amount of mineral acids present is insufficient to neutralise all the bases, carbonates will be found in the ash; if, on the other hand, mineral acids predominate, carbonates are absent. This latter is, I believe, rarely or never the case in an absolutely pure natural wine, though it may happen in a wine which yet ought not, on that account, to be called adulterated. It is sometimes found absolutely essential for the preservation of a wine to charge it slightly with sulphurous acid: this, in the course of time, becomes sulphuric acid, and thus the mineral acids are increased, and may outbalance the bases. In some cases the must is charged with sulphurous acid, which of course has the same effect. If, on the other hand, a sour wine has been partially neutralised by the addition of alkali, carbonates will be found in excess in the ash, which of course will also be more than it should be. In many southern countries, notably in Spain, it is the custom to add plaster of Paris to the must, or rather this is thrown on to the grapes before they are crushed. Now, the sulphate of calcium added and the cream of tartar contained in the must—both of which would be almost insoluble in the finished wine—yield soluble sulphate of potassium, insoluble tartrate of calcium, and some free sulphuric acid. One of the effects of the plastering is thus a notable increase in the amount of ash left by the wine, due to the production of soluble sulphate of potassium in place of the almost insoluble cream of tartar. In wines so treated—as, for example, in all sherries—the ash frequently rises to 0·5, or even more, per cent. The part of the ash soluble in water is in these cases chiefly—in many cases even entirely—composed of sulphate of potassium, because the small amount of sulphuric acid, produced as above described, increased not unfrequently by the sulphuring of the must or wine in the course of evaporation and incineration, expels the hydrochloric acid from the chlorides, and of course prevents the production of carbonates. Such wines frequently contain more sulphuric acid than can combine with the bases present, and accordingly we find more sulphuric acid in the wine itself than in its ash. No wine is met with free from chlorides. It may be worth while to point out a material difference in the effect of sulphuring and plastering must or wine, both of which processes increase the amount of sulphuric acid in the wine. The effect of sulphuring is simply a substitution in the ash of sulphuric acid for chlorine and carbonic acids. It may have the effect of expelling both these from the ash, or even of producing a trace of free sulphuric acid in the wine, but it does not materially increase the proportion of ash found. Plastering, on the other hand, by changing—as above described—the difficultly soluble cream of tartar into soluble sulphate of potassium, very materially increases the proportion of ash afterwards yielded by the wine.

Total Dry Residue and Extractives.—Pure natural wines generally leave from 1·5 to 3 per cent of total residue on evaporation. In fortified wines and champagnes this total residue frequently rises to 6, 8, or even 10 per cent, the greater proportion consisting, in these cases, of sugar. In some liqueur wines the residue rises up to 25 per cent or more. If from this residue we subtract all those substances at present admitting of estimation, a certain proportion will be found unaccounted for. This constitutes what are generally called the extractives. No genuine wine is free from these. In wines free, or almost free, from sugar, these extractives usually constitute the greater portion of the total residue.

A table giving a few analyses of each of the principal wines imported, with the report of the discussion, will appear in our next number.

NOTICES OF BOOKS.

Sun and Earth as Great Forces in Chemistry. By T. W. HALL, M.D. London: Trübner and Co.

THE title of this work may possibly at first lead the reader to imagine that it treats of some new form of force of which the sun and the earth are the sources. This, however, is an error. The sun is viewed here merely as a source of heat. The author, moreover, speaks of the "sun and all other heat sources" of "the sun and of secondary sources," &c. Thus it may be fairly asked whether the word "sun" is not here a mere synonym for heat in the widest sense of the word, whether enanating from the sun, the fixed stars, or from the earth. Now that heat is a "great force" in chemistry is universally admitted, even by those who may not feel disposed to grant the author's view that the entire of chemical phenomena are merely "heat acting upon matter." It strikes us that there is at present a tendency rather to overrate than to neglect the chemical importance of heat, and to make chemistry a mere subsidiary province of thermotics, just as at one time it was viewed too exclusively as a department of electricity.

We will, however, endeavour as briefly and as fairly as possible to place Dr. Hall's leading views before our readers. He declares that on our globe, for every portion of matter or chemical, there exists a great, equal, and constant heat-source, the average quantity of heat supplied to the earth by the sun. This average quantity, however, fluctuates to such an extent as greatly to affect the aggregate condition of various substances. Mercury is frequently a solid at Nertchinsk, and ether a vapour in equatorial Africa. For every portion of matter or chemical there exist also its brother chemicals, and one vast chemical, the whole earth.

We perceive that "chemical" is used by the author as strictly synonymous with "matter." But any portion of matter can only be regarded as a "chemical" in so far forth as it is capable of entering into chemical reaction. When its strongest affinities under existing circumstances

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are gratified, and it is brought into a state of equilibrium, it ceases to be a chemical, just as the weight of a clock which has run down ceases to be a weight as far as the clock is concerned. This is the case with the great bulk of matter of which the earth, or at least those parts of it known to man, is composed. Each element has combined with those other elements which were accessible, and for which, under existing circumstances, it has the greatest affinity. Does it not then cease to be a "chemical" until the existing equilibrium is disturbed? Chemical action is not modified by the proximity of foreign bodies, unless they are volatile. To return :—

Further, in a chemical there exists a heat constitution, that is, conductivity and capacity for making heat in various ways latent; this heat constitution has a double function of giving and taking heat: from the hotter a chemical, by its heat constitution, takes heat; to a colder the chemical, by the same constitution, equally gives heat. Further, latent and allotropic heat are correlated to state, form, dilatation, &c., of matter or chemicals. Hence, chemicals, say the elements, are subject in our planet by virtue of their heat constitution to two forces, sun-heat and earth-heat, which last, compared with sun-heat is coldness, and from the correlation that exists between state, form, dilatation, &c., of matter, and latent and allotropic heat we can demonstrate sun effects and earth effects upon chemicals. The tendency of sun-heat acting upon matter through matter's heat constitution will always be to give matter latent heat, or to make matter gaseous, or to expand matter. The tendency of the earth's coldness will be to diminish matter's latent heat, or to make matter solid, or to contract it. Hence, sun effects are antagonistic to earth effects; and when sun-heat in our planet raises matter to a gas, sun-heat does so by coercing the earth's antagonistic tendency to make matter solid. Hence, sun-heat so occupied is a force neutralised by another force, and seems to disappear or become latent.

Chemical elements, being subject to two forces and having different heat constitutions, take some of the earth's coldness, and others the sun's heat; hence, some elements are solids and others are gaseous, &c.

Now that the temperature of the earth is lower than that of the sun no one will dispute. Still she radiates heat out into space though non-luminous and of a lower tension. How, then, can she be a source of "coldness" acting antagonistically to the sun? Suppose her altogether withdrawn, would a given body, now lying on her surface, become hotter or colder? Experience tells us that if we remove bodies from her influence even to the small distance which can be reached in a balloon ascent, their state of aggregation is altered. Solids contract and liquids solidify. Surely, then, we are compelled to admit that the earth does not, in this respect, act as the antagonist, but as the assistant of the sun. That she has any tendency to make matter solid by her "coldness" is an utterly unproved hypothesis.

We regret that we do not recognise in this work any principle which appears to be at once true and fruitful,—the conditions which may be fairly required of every new theory.

Journal of the Society for the Promotion of Scientific Industry. Vol. i., No. 2; October, 1874. Manchester: published by the Society.

This number contains the commencement of a memoir on "Anthracen and its Derivatives," by Dr. G. Auerbach, and an account of the pâte-sur-pâte style of decorating ceramic ware, by E. Loche.

Mr. G. E. Davis gives an interesting account of the new salt-cake process as carried on at the Atlas Works, Widnes (Messrs. Hargreaves and Robinson). The sulphurous acid gas from the pyrites-burners, mixed with steam and atmospheric air, is passed directly over the salt without the use of lead chambers. The patentees state that the total consumption of fuel amounts to 12 cwts. for every ton of salt-cake produced. A fair average sample of the cake produced showed :—

Insoluble matter	1·989
Sulphate of alumina..	1·062
Sulphate of lime	1·605
Sulphate of soda	94·582
Chloride of sodium	0·052
Free sulphuric acid	0·648
	99·938

There is also an anonymous paper on the utilisation of peat, and a letter by Mr. C. Dreyfuss on the recent progress made in the dyeing and printing of calico.

Monthly Report of the Department of Agriculture for October, 1874. Washington: Government Printing Office.

This is an official document replete with valuable information on the condition and progress of agriculture in the United States. Passing over the statistical department, market reports, &c., we find among the Chemical Memoranda an account of a "curious deposit of phosphatic material" found in a cave near Savannah. No account is given of its extent or surroundings, but it is described as "white, pulverulent, becoming lumpy upon compression, and apparently the result of decomposition."

On analysis it was found to contain :—

Insoluble silica	6·20
Soluble silica	0·60
Lime	14·32
Magnesia	3·43
Alumina	13·53
Peroxide of iron	7·34
Soluble phosphoric acid	8·40
Insoluble phosphoric acid ..	6·10
Potash	2·53
Soda	0·375
Sulphuric acid	3·87
Chlorine	trace
Nitric acid	trace
Carbonic acid	trace
Moisture	16·10
*Organic matter	16·25
	99·045

* Containing nitrogen = 0·1445 of ammonia.

That this substance must have considerable manurial value is not to be doubted. But its origin is problematical. From the guanos it is distinguished by its large proportion of alumina and iron no less than of soluble phosphoric acid. 16 per cent of organic matter with only 0·119 per cent of nitrogen is also remarkable. It is to be regretted that the author of the memoir did not make a separate analysis of the soluble and insoluble portions.

Observations are quoted proving that both the rainfall and the atmospheric moisture are measurably greater in forests than in denuded districts in situations otherwise similar.

Experiments have been undertaken with a view of proving the identity of *Pemphigus vitifoliæ*, (the leaf-gall louse of Fitch) with the well known *Phylloxera vastatrix*. The results were negative. America seems to be suffering very extensively from a number of insect pests whose weak side has not been hitherto discovered.

Report of the Commissioner of Agriculture for the Year 1873. Washington: Government Printing Office.

This report contains a vast and well assorted store of information. Turning naturally to the chemical department, we find analyses of some marls and natural manures which are in extensive use. One from Abingdon, Virginia, consists of :—

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Moisture	0·100
Silica	34·655
Peroxide of iron and alumina	14·542
Phosphoric acid	0·563
Lime	22·207
Magnesia	9·614
Carbonic acid	17·448
Alkalies	traces
Loss	0·871
	100·000

This is said to have "produced a very marked and beneficial effect" on corn till the dry weather set in. Such a result in the absence of nitrogen and potash, and with so small an amount of phosphoric acid is remarkable.

A kind of guano found in a cavern near Huntsville, Alabama, and supposed to consist of the modified excrements of bats gave :—

Moisture	11·600
Silica, insoluble	30·810
„ soluble	3·180
Organic matter, insoluble	28·687
„ „ soluble	10·573
Free ammonia	trace
Phosphoric acid, insoluble	1·5016
„ „ soluble	1·305
Peroxide of iron	1·428
Alumina	3·210
Lime	4·110
Magnesia	3·110
Soda	0·312
Nitric acid	0·122
	99·9486

The total amount of nitrogen is 3·72 per cent.

Some experiments on opium growing have been made in the United States. Samples from North Carolina yielded 5·01 per cent of morphia; from California, 5·75 per cent; but from Vermont, 15·75, which last result is higher than the average Smyrna quality.

Mention is made of a soil in South Carolina which has the appearance of fertility, but in which cotton cannot be raised. The mischief is ascribed with great probability to the presence of proto-sulphate of iron, and a heavy dressing of lime is recommended.

The microscopic investigations by Mr. T. Taylor, on the phenomena of various blights, including the potato disease, are very interesting.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 6, February 8, 1875.

Magnetisation of Steel Bars Fitted with Armatures.—M. J. Jamin.—The author's researches point to an important modification in the construction of magnets. Supposing a great number of plates, which, after being separately magnetised to saturation, are placed together. The magnetism of the combination will be seen to increase up to a limit which cannot be passed, and which is reached when the polar surfaces are filled. Suppose that ten plates are required. If now we re-commence the same experiment, applying the same plates against two iron armatures of a large surface, the intensities will increase much more slowly, because the sum of the magnetism is diffused over a more considerable extent, and the limit will not be reached till this extent is full. For this it may be needful to superpose 20, 30, or 40 plates, and, generally speaking, a number so much the greater as the armatures are larger. The total power of the magnet will, therefore, increase with its armatures.

M. Menier's Communication on the Pulverisation of Manures.—M. Chevreul.—The author points out that M. Menier exaggerates the influence of mechanical subdivision.

Optical (Double Refractory) Characteristics of the Four Principal Triclinic Felspars, and on a Process for their Immediate Recognition.—M. Des Cloizeaux. This interesting mineralogical paper cannot be made intelligible without the accompanying six diagrams.

M. Mendeleef's New Balance. M. Salleron.—This paper is also useless without the accompanying diagrams.

New Electro-Magnet formed of Concentric Iron Tubes, Separated by Coils of a Conducting Wire. M. J. Camacho.—Already noticed.

New Note on the Molecular Equilibrium of Solutions of Chrome Alum.—M. Lecoq de Boisbaudran.—A continuation of the controversy between the author and M. Gernez.

Note on the Action of the Hydrate of Baryta on Certain Mineral and Organic Compounds contained in the Products of Beet-Root.—M. P. Lagrange.—The author recommends the hydrate of baryta for eliminating all phosphoric acid from the potash obtained from the residues of the beet-root sugar works.

Certain Beet-Roots called "Rootz" (Racineuser).—M. Ch. Viollette.—The author contests the view of M. Peligot that the percentage of sugar depends on the quality of the seed. He considers that a poor yield generally results in a clayey, compact, irregular soil.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin No. 16, 1874.

Presence of a Diastatic and Pepton-Forming Ferment in the Seeds of Tares.—V. Gorup-Besanez.—The constant occurrence of leucin and asparagin in the germs of tares (when germination took place in the absence of sun-light) was shown by a series of experiments conducted by H. H. Will under the author's supervision. In a further series of experiments, where tares were sowed in garden-earth under normal conditions, both these compounds were found to be absent. They were also absent in the seeds. That albumenoids present in the seeds undergo transformation during the process of germination was rendered very probable by the circumstance that the legumin present in the seeds is no longer to be found in the young shoots. It was, in fact, demonstrated by a number of carefully executed experiments that there is contained in the seeds of tares a ferment, capable of being extracted by glycerin, and which very energetically converts starch into glucose and albumenoids (fibrin into peptones). The author is engaged with further experiments on the preparation of this ferment in a state of purity.

Reduction of Benzo-Phenon.—W. Staedel.—With reference to the experiments of M. P. Barbier (*Comptes Rendus*, lxxix., p. 810) the author states that on gently heating an intimate mixture of pulverised benzo-phenon (perfectly pure) and of zinc-powder in a combustion-tube, he invariably obtained diphenyl-methan in abundance.

Oxidation of Ammonia by Ozone.—L. Carius.—The author obtained as products of this reaction nitrite of ammonia and peroxide of hydrogen.

Explanation.—J. Piccard.—This "explanation" relates to a "reclamation" by H. Hlasiwetz in an earlier number of the *Berichte*.

Degradation of the Colour of Vermillion, Occasioned by Contact with Copper and Brass.—K. Heumann.—This paper has already appeared.

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Chlorinised Phenyl-Mustard Oil and its Derivatives. F. Beilstein and A. Kurbatow.—The authors have obtained dipara-chlor-phenyl-sulph-urea, $CS(NC_6H_4ClH)_2$, from para-chlor-aniline, CS_2, and alcohol; it forms white, shining needles, melting at 168°. Para-chlor-phenyl-mustard oil, $CSNC_6H_4Cl$, cannot be advantageously prepared from sulph-urea and P_2O_5, the yield being too small. It forms long shining needles, which melt at 45° to 47°. Tri-para-chlor-phenyl guanidin, $C_{19}H_{14}Cl_3N_3$, crystallises in fine needles. It is soluble in alcohol and ether, insoluble in water. If heated with CS_2 to 230° it is resolved into oil of mustard and sulph-urea.

Alkaloid Body in the Organism.—A. Dupré.—As regards the communications of Selmi, Rörsch and Fassbender, and Schwanert (*Berichte*, vi., 142; and vii., 1064 and 1332) it must be remarked that Bence Jones and the author, in 1866, pointed out the existence of an alkaloid in all organs, tissues, and fluids of the human and animal body (*Proc. Roy. Soc.*, xv., p. 73; *Jahresberichte*, 1866, 753; and *Zeitschrift fur Chem.*, 1866, 348).

Communication on Raw and Pure Wood-Spirit.—M. Grodzki and G. Kraemer.—In addition to its well-known constituents, aceton, acetate of methyl and methyic alcohol, mesitylic oxide, and phoron, allylic alcohol must be regarded as constantly present in raw wood-spirit.

Preparation of Gaseous Hydriodic Acid.—A. Bannow.—The author finds Topsoe's method for the preparation of pure hydrobromic acid available also for the hydriodic. Red phosphorus is put in a tubulated retort, and a solution of 2 parts of iodine in 1 part of liquid hydriodic acid, of 1·7, is allowed to enter gradually through a dropping-funnel. The development takes place at first without the aid of heat. After the whole of the iodine has been added a gentle heat may be applied. The proportions should be arranged so that iodine and phosphorus may act upon each other according to the formula P_2I_5. If heat is applied too early a considerable sublimate of iodophosphonium is obtained.

Interesting Oxidation of Metallic Aluminium.—C. Jehn and H. Hinze.—A piece of aluminium was rubbed strongly upon white soft leather, which was saturated with mercury. The rubbed metallic surface became hot and dull, and in a few moments white protuberances, about 3 m.m. in height, gradually grew out of it. On examination they proved to be pure alumina. Aluminium rubbed without the presence of mercury is not oxidised.

Action of Bromine upon Aldehyd.—A. Pinner.—Upon paraldehyd, diluted with twice its weight of glacial acetic acid, and kept cool by being surrounded with water, bromine was allowed to flow very slowly. The drops dissolve at first in the aldehyd, and colour it a pale yellow. After a short time the temperature rises, and the yellow colour disappears. On further additions of bromine the liquid becomes deeper coloured, but the reaction does not cease till 3 equivalents of bromine have been added. In this manner the author obtained bibromaldehyd and tribromaldehyd, or bromal.

Ortho-Brom-Benzoic Acid.—Th. Zincke.—Not adapted for abstraction.

Action of Reducing Agents upon Benzo-Nitranilin and Benzo-Nitro-Toluydin.—Chichester A. Bell.—The author concludes from his experiments that in the benzol derivatives of meta-nitranilin (melting-point 110°), and meta-nitro-toluydin (melting-point 77·5°), the acid group cannot be reduced.

The Pseudo-Nitrols.—V. Meyer and J. Löcher.—Not adapted for abstraction.

Diagnosis of Primary, Secondary, and Tertiary [illegible] and Alcohol-Radicals by Colour Reactions. and J. Löcher.—Reserved for future insertion.

-Toluol.—P. Jannasch and A. Dieckmann. rs have undertaken the synthesis of ethyl-ara-brom-toluol, iodide of ethyl and sodium. The reaction was somewhat slow. Pure benzol was used as solvent. Lare quantities of para-brom-toluol must never be decomposed at once.

Reduction of Metallic Oxides by Hydrogen, and Application to the Detection and Quantitative Determination of Metals.—W. Müller.—Reserved for future insertion.

Remarks on the Paper by N. Sokoloff and P. Latschinoff on the Action of Ammonia upon Aceton.—W. Heintz.—A controversial notice of the article (*Berichte*, vii., p. 1384.

"In Defence."—Ernst Schmidt.—A reply to Liebermann's critique on the author's memoir on anthracen and chrysen.

Application of the Nitric Oxide and Sulphide of Carbon Light to Photographic Purposes.—E. Sell.—The author has anticipated MM. Delachanal and Mermet (see *Comptes Rendus*, November 9, 1874) in the application of this light to photographic purposes, and had patented it in England October 10, 1873, No. 3288.

Forty-Seventh Meeting of German Naturalists and Physicians, Held at Breslau, September 18th to 24th, 1874 (Chemical Section).—Reported by R. Biedermann and H. Römer.—In the opentng address Löwig called particular attention to the merits of J. B. Richter, the "Kepler of Chemistry, and discoverer of the law of chemical proportions."

F. v. Heyden spoke on salicylic acid, which he had prepared by Kolbe's method on the large scale.

E. Schmidt gave an account of the oxidation-products of isobutylic alcohol, of methyl-isopropyl-keton, of the sulph-acids of naphthyl-aniline, and of the action of sulphuretted hydrogen upon alkaloids.

Heumann described certain compounds of mercury and copper, *Berichte*, pp. 1388 and 1390.

J. Muller reported on the occurrence of pyrocatechin in the urine of a child.

H. Landolt exhibited some interesting experiments with "inverted flames."

Dr. Lunge, of South Shields, gave an interesting account of the most recent improvements in the alkali manufacture, with especial reference to English establishments. His speech was illustrated by detailed statistics and the exhibition of plans. He first described certain changes in the manufacture of sulphuric acid, especially the introduction of Glover's tower, now very general in England, and the treatment of cupriferous pyrites. These have almost banished other sources of sulphur from England, the burnt ores being worked both for copper and iron. It is highly probable that the manufacture of sulphuric acid will soon be eliminated from the sphere of the alkali trade, since the process of Hargreaves, by which sulphate of soda is produced by the action of sulphurous acid and air upon chloride of sodium, proves satisfactory in practice, and is already carried out on a large scale in four establishments in England. Three more are in course of completion. In the soda manufacture, in the strict sense of the word, Leblanc's method is still supreme. Two small works for the ammonia process are being erected, but the majority of English manufacturers have no faith in this method. In the ordinary process the revolving soda furnaces have overcome all difficulties, and the abolition of the furnaces requiring manual labour is, in England, merely a question of time. In the manufacture of chloride of lime and chlorate of potash the complete abandonment of the old manganese process is still closer at hand. As for the new methods, that of Dunlop (conversion of manganic chloride with carbonate of lime by means of steam at a tension of 2 to 4 atmospheres, and calcination of the carbonate of manganese at 300° to 400°) is only at use at St. Rollox, near Glasgow—not even in the branch establishment of the same firm at Newcastle, where Weldon's process is in operation. The quantity of chloride of lime and chlorate of potash—the latter estimated at seven times its weight of the former—made in England in the current year is—

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Made with manganese	10,000 tons.
Made by Dunlop's process	10,000 ,,
Made by Deacon's process	5000 ,,
Made by Weldon's regeneration process	60,000 ,,
	85,000

The decision between the processes of Deacon and Dunlop is no longer doubtful. In England, twelve works have been built on the former principle, seven of which are already quite out of use, and the remaining five in a very imperfect state. In the rest of the world there are only two, recently commenced in Germany. The failure of this beautiful and promising process springs from the circumstance that the balls of clay, saturated with sulphate of copper, cease to act. On Weldon's system there are in England—

	Establishments.	With Oxidation-Towers.
At work	32	54
Building	15	23
	47	77

These are said to produce 80,000 tons yearly, but their full power is 150,000: eight or nine more works are projected. There is one in Belgium; in France three are in course of erection, and one is projected; in Germany there are one or two at Saarau.

A. Mitscherlich read a paper on his new method of elementary organic analysis. The apparatus cannot be described without the aid of illustrations (*Berichte*, vi., p. 1000).

H. Fittica gave a communication on isomeric nitro-toluylic acids, azo-toluylic acids, and on a second cymol-sulphuric acid.

E. Nölting gave the results of his researches on brom-benzol-sulphuric acid and its derivatives.

Otto Witt described certain new colouring matters—those of Croissant and Bretonnière,—and on a method for preparing organic cyanides. The colours he regards as produced by the action of alkaline sulph-hydrates upon hydrates of carbon.

H. Biedermann spoke concerning the "replacement of the amido group in nitramins by hydroxyl," by means of boiling with concentrated soda-lye.

A. Mitscherlich communicated the results of his observations on the "combustion-point."

H. Kral showed that oleic acid absorbs great quantities of oxygen, and converts it into ozone. When used in lamps it develops a strong light and an extraordinary heat.

H. Maschke recommended hæmatoxylin as an indicator in alkalimetry.

Dr. Franck complained of the present neglect of mineral chemistry.

Prof. Bœttger gave a communication on the detection of ammonia, nitrites, and nitrates in potable waters. He gave instructions for preparing the iodide of cadmium and starch test-liquor for detecting nitrites. By previously treating samples of water with cadmium and dilute sulphuric acid nitrates, if present, are reduced to nitrates, and may be detected by the same test-liquor.

H. Bœttger proposed stannite of soda for recovering gold from weak baths. He showed that a galvanic coating of nickel, being less porous than gold, protected iron better against rust. To obtain salts of nickel free from iron, the solution is acidulated, and carbonate of soda added till a little carbonate of nickel is thrown down. The mixture is boiled for half-an-hour, when the solution will be found quite free from iron.

H. Maschke exhibited Goppelsroeder's test for alumina. If to a dilute solution of this earth a trace of very dilute alcoholic solution of morin is added, a green colouration appears.

Report of the Mineralogical and Geological Section.—H. Römer.—H. Schuchardt explained the composition of Vesczelyte, a mineral lately discovered by Vesczely in the Delius mine, near Moriwiza, in the Banat. It is a phosphate of copper with 4CuO. The following series is thus known:—

Libethenite ..	$4CuO,P_2O_5 + H_2O$.
Tagilite	$4CuO,P_2O_5 + 3H_2O$.
Vesczelyte	$4CuO,P_2O_5,+5H_2O$.

H. von Lasaul described "Siegburgite," a new fossil resin from Sieburg, near Bonn, distinguished for its high proportion of carbon—85 per cent.

H. Frank described some experiments for the artificial production of Kieserite ($MgSO_4+H_2O$), and Thenardite (Na_2SO_4).

Prof. F. Römer gave an abstract of Harting's paper on a fulgurite found at Elspeet, in Geldern, August 11, 1872.

Liebig's Annalen der Chemie und Pharmacie.
Heft 1 and 2, 1874.

Behaviour of Neurin with Albumenoids.—Julius Mauthner.—The author finds that fibrin if mixed with a solution of neurin, even very dilute, and boiled, or set aside in the cold, swells strongly, and dissolves at last completely. The solution, in a dilute state, can be readily filtered. It is not precipitated on the addition of alcohol, and does not blacken sugar of lead on boiling. If common salt is added in excess the fibrin is precipitated, but re-dissolves on the addition of an excess of water. The addition of acids produces a copious, white, flocculent precipitate, soluble in excess of acid, which when dried appeared as an amorphous, brittle, hard, brown substance. It was found to contain, on analysis,—

Carbon	52·73
Hydrogen	7·26
Nitrogen	15·65

With egg-albumen the behaviour of neurin is similar. These two bodies may be boiled together without coagulation, and coagulated albumen dissolves in neurin.

Constitution of the Uric Acid Group.—Dr. L. Medicus.—A hypothetical paper.

Communication from the Laboratory of the University of Halle.—This consists of an examination of the behaviour of hydrochlorate of diacetonamin on exposure to heat, by W. Heintz.

MISCELLANEOUS.

The Faraday Lecture.—The triennial "Faraday Lecture" of the Chemical Society was delivered last evening, in the theatre of the Royal Institution, by Dr. A. W. Hofmann, of Berlin, before the Prince of Wales and a crowded meeting, which included a number of the most distinguished members of the English scientific world, the subject being "Liebig's Contributions to Experimental Chemisry." On concluding, the lecturer was presented by Dr. Odling, F.R.S., with the Faraday gold medal, the award of which is the highest honour the Society has the power of conferring. A report of the Lecture will shortly appear in these columns.

NOTES AND QUERIES.

Ultramarine.—In reply to "A. O.," we give at foot a list of the English ultramarine manufacturers.—A. Keiffenheim & Co.

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THE CHEMICAL NEWS.

Vol. XXXI. No. 800.

PROCESS FOR THE ESTIMATION OF COLOUR IN WATER.*

By J. FALCONER KING, City Analyst, Edinburgh.

During the later months of the year 1873 and the spring of 1874, I had occasion to examine and report upon many samples of water, chiefly in connection with the water supply of Edinburgh.

As is well known, there were several schemes proposed for the supply of the city, and samples of water from most of them were submitted to me for examination.

The analyses, as usually performed, showed all these waters to be very much alike, because the main and almost only difference between them was the extent to which they were coloured. By the ordinary mode of analysis hitherto in general use, this most important feature would either not have been described at all, or would have been described in language so vague as to be totally unintelligible. We find, for instance, in many reports of analyses of water, the colour stated as being much or little, or by some meaningless or incomparable terms, as yellowish or brownish, which are altogether without significance, as no one can tell with precision what is wished to be indicated by such vague expressions, and which preclude the possibility of comparison, or of the character of the water being accurately recorded, as that tint which one observer would consider as fairly characterised by one name, might quite possibly, and would indeed most probably, be in the opinion of another deserving of quite a different appellation. In addition, therefore, to the usual details set forth in reports of water analyses, I found that in order to permit of the merits and demerits of these different waters being properly discussed, compared, and recorded, it would be necessary to have the depth of colour of each exactly and definitely stated. To enable me to do this, I elaborated a process for the estimation of colour in water, which I will now have the pleasure of describing to the Society, and which, I may add, has lately been employed both by myself and others, and has been found in every way satisfactory.

The process, which is extremely simple, consists in adding to a known quantity of pure distilled water contained in a glass tube, an aqueous solution of caramel, of a certain strength, from a burette, until the tint communicated to the distilled water is found to equal that of the water under examination.

The tubes I employ are made of glass as free from colour as possible; they should be 15 inches long, and of such diameter that when filled to within 3 inches of the top, they will contain 8 ounces of water exactly.

Preparing the standard solution of caramel is the only part of the operation attended with any difficulty. It is done by adding caramel to distilled water until the proper depth of tint has been attained. The depth of colour which it should possess is ascertained as follows:—To 8 ounces of *pure* water, perfectly free from ammonia, contained in a glass tube, and forming a column 12 inches long, add 10 grains by volume of solution of ammonium chloride, containing 3·17 grains of the salt in 10,000 grains of water (or 0·0001 grain of ammonia in 1 grain of solution). To this mixture, after proper agitation, add 25 grains by volume of Nessler's solution, of the usual strength; allow this, after mixing, to repose for ten minutes, at a temperature of 60° F., when the colour produced will equal 30° on my scale. That is, 300 grains by volume, or 30° (a degree being equal to 10 grains by volume) of caramel solution, if of proper strength, will produce exactly the same depth of colour when added to the same amount of distilled water (8 ounces) in a column 12 inches long.

The caramel solution, which I should state can be kept unchanged for a considerable length of time, being thus prepared, all that is necessary to do to estimate the colour of a water, is to fill two tubes, of the dimensions stated above, to within 3 inches of the top, one with distilled water, and the other with the water to be tested; and having placed them side by side on a white slab, in a good light, to add the caramel solution from a burette to the distilled water, until that is found to equal in colour the water contained in the other tube. The burette being graduated in grains, every 10 grains consumed will represent one degree of colour. The intensity of the colour is ascertained by looking down through the length of the column.

This process I have found very efficacious, which fact, with its extreme simplicity, will, I believe, recommend it to all who, like myself, have occasion to examine numerous samples of water.

* A paper read before the Royal Physical Society.

COAL IN RUSSIA.

(Analyses of some Samples).

By SERGIUS KERN, St. Petersburg.

The fields of best coal in Russia are situated on the Donetz Mountains. Lately, good coal was found on the Oural Mountains. Besides these coal-fields, coal is known in the Governments of Toula and Riasane, also not far from Petersburg in the Governments of Tver and Nowgorod. Some analyses which I annex are the results of my work. In estimating the calorific power of coals, Rumford's calorimeter was used.

Government of Nowgorod.—The coal found here is properly brown-coal (lignite); contains 3—6 per cent of sulphur; quartz, fire-clay, iron-ore, pyrites, in the neighbourhood.

1. River Prikcha, 30 miles to the N. from the town Borovitchi:—

	Per cent.
Carbon	36·70
Volatile matter	46·80
Ash	16·50
	100·00

4500 calorific units; contains 18·90 per cent hygroscopic water; dried coal gives 62·18 per cent coke; 6200 cubic feet of gas per ton.

2. Dried coke from the coal of Prikcha:—

	Per cent.
Carbon	78·03
Volatile matter	10·71
Ash	11·26
	100·00

5910 calorific units; coke good for reverberatory furnaces.

Government Toula.—The coal is found 30—70 feet from the surface; iron-ore near the collieries.

3. Obidimovo, on the Riask-Viasma railway-line; 15 miles from Toula:—

	Per cent.
Carbon	39·14
Volatile matter	42·65
Ash	18·21
	100·00

4100 calorific units; hygroscopic water 2·55 per cent; 3·23 per cent of sulphur; the coal resembles Scotch bog-head-coal.

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Government Riasane.—The coal here found is good for reverberatory furnaces and gas-manufacture.

4. Colliery "Mouraevna."—Contains 2·40 per cent of sulphur; 5485 calorific units:—

	Per cent.
Carbon	17·60
Volatile matter	66·26
Ash	8·61
Hygroscopic water	7·53
	100·00

Oural Mountains.—Good coal in many places, but not explored.

5. Coal from Vaschkour, near the river Tchousovaya; 7320 calorific units; gives good coke:—

	Per cent.
Carbon	77·86
Volatile matter	12·30
Ash	2·72
Hygroscopic water	7·12
	100·00

Donetz Mountains.—Vast fields of good coal and best known anthracite, which is used in these places for working blast-furnaces.

6. The "Grouschevka" mine, situated on the Rostov-Voronege railway line; 7640 calorific units:—

	Per cent.
Carbon	90 80
Volatile matter	7·22
Ash	1·98
	100·00

7. Village Alexandrovka: good coal; gives very compact coke; 7690 calorific units; 0·36 per cent of sulphur:—

	Per cent.
Carbon	69·92
Volatile matter	29·00
Ash	1·08
	100·00

8. Village Ouspenskoe, near the town Backmouth: 7970 calorific units; 0·87 per cent of sulphur; the coal gives good coke:—

	Per cent.
Carbon	64·85
Volatile matter	28·90
Ash	6·25
	100·00

DIAGNOSIS OF PRIMARY, SECONDARY, AND TERTIARY ALCOHOLS AND ALCOHOL-RADICALS BY COLOUR-REACTIONS.

By VICTOR MEYER and J. LÖCHER.

If it is required to decide whether an iodide of the series $C_nH_{2n+1}I$ contains a primary, secondary, or tertiary alcohol-radical, it is distilled with nitrite of silver, and the distillate is treated with potash and nitrous acid. If a red colouration is obtained (formation of nitrolic acid), we have certainly a primary alcohol-radical; a blue colour shows a secondary; and the absence of colour a tertiary. As the alcohols are very readily converted into iodides, and these again into nitro compounds, the idea suggested itself that the colour-phenomena observed might be advantageously used for the distinction of very small quantities of the primary, secondary, and tertiary iodides, and consequence of the alcohols. The authors have found, that from 0·3 to 0·5 of a gramme is sufficient to [illegible] iodide belongs to the primary, secondary, With the iodides poor in carbon (of the methylic-propylic series), 0·3 grm. is sufficient for the production of the characteristic colour. In those richer in carbon, especially of the secondary and tertiary series, 0·5 grm. of the iodide will be needed. In case of compounds very rich in carbon, the use of 1 grm. might be recommended. The following arrangement has been found convenient:—Into a distilling-flask of a few c.c. capacity, with a tube of 4 or 5 inches in length blown in the side, is put a small quantity of dry nitrite of silver (double the weight of the iodide), previously rubbed up with its own volume of fine white sand. The iodide is then added, waiting a few moments until the reaction sets in, when it is distilled over the naked flame without condenser, receiving the distillate in a narrow test-tube. The distillate consists of several drops, and displays the characteristic reaction with great distinctness.—*Berichte d. Deutsch. Chem. Gessel. zu Berlin.*

ON THE MANUFACTURE OF CAUSTIC SODA.*

By JOHN MORRISON, F.C.S.

(Continued from page 123)

Nitreing occupies five or six hours, and in those works adopting it about 10 per cent less pot room is necessary, for the violent commotion produced by blowing renders it impossible to fill the pots to the extent admissible in the case of nitreing. The oxidation process at an end, the pot is fired to redness—if not already in that state—and a sample is drawn to ascertain its exact strength. If prepared for 60's, it usually turns out 68—70 per cent; but if for 70's, 70—72 per cent. In either case, it is brought down to the desired strength—that is to say about 1° below 60 or 70 per cent, as the case may be (for the "Liverpool" test usually ranges 1 to 2 per cent beyond the ordinary commercial one)—by the addition of common salt. This, however, lowers the temperature, which must be brought up again by continuing the firing. The salt of course decrepitates violently on coming in contact with the intensely heated mass, and it causes a fine spray surcharged with particles of caustic soda, which produces a new edition of the effects alluded to in speaking of the last stages of concentration. There are, indeed, no less than three objectionable periods in caustic finishing—the nitreing being likewise very unpleasant—which are, I think, in the like order of their occurrence, progressively vicious in their tendencies. The salting is so particularly irritating, that it is usual for the workmen to wear veils and gauntlets for the protection of their faces and arms during this operation. On the conclusion of the salting process, if the lid be withdrawn to one side, the graphite may be seen covering the surface of the batch in the form of a fine metallic-looking film; but when after the reheating which is necessary to ensure proper settling, the lid is removed, the unconsumed portion displays the forms of cinder-like pieces floating here and there on the top of the intensely heated mass. The ultramarine also appears at this stage, coating the rim of the pot and edges of the lid with a blue amorphous-looking deposit.

The pot will be ready for packing within eight to twelve hours of the final removal of the lid, and simultaneous slacking of the fire. This operation is performed by baling. Two or more rows of drums are placed round the working side of the pot, within the radius or sweep of a sheet-iron packing shoot, into the wider end of which the perfectly liquid caustic soda is poured from an iron ladle. If the caustic be up to the mark, it will appear beautifully limpid and colourless—or, according to the workmen's loftier standard, "clear as gin"—as it is delivered from the ladle; and if this be not its condition, and the slightest degree of turbidity be manifested, the product will not be up to the mark when cool; and even though samples drawn from the lid may appear everything to be desired,

* A Paper read before the Newcastle-upon-Tyne Chemical Society.

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if the drum be broken the centre or core will be of a dirty grey colour.

On approaching the lower portion of the pot, the workman proceeds very carefully; and as soon as the caustic appears at all doubtful, he ceases to pack, and commences baling the dubious portion into an adjoining pot of strong liquor till he comes to what are termed the "bottoms." Then he plunges the whole thoroughly with his ladle, and packs the red dirty-looking sediment into speeial drums for sale as "bottoms," or transfers it into iron bogies to be broken up when cool, and re-dissolved in a small "mashing" pan kept for the purpose and provided with a steam pipe, along with any fished salts, scrapings, fluxings, and in fact, any alkaline rubbish too valuable to be thrown away and too inferior to be otherwise utilised. When dissolved to about 48° T., the charge is thoroughly settled, and the supernatant liquor drawn off and causticised, or transferred to settlers for treatment in a manner yet to be described. The deposit consists chiefly of peroxide of iron, and is, after washing, thrown away.

Such, then, is the usual process for the manufacture of white caustic soda; but in the case of cream, a different treatment is necessary. Cream caustic may be manufactured from vat liquor solely, but is better if made of "red" liquor, or the dissolved bottoms just spoken of, either alone or in conjunction with a portion of vat liquor, and it may be prepared either from causticised or uncausticised liquor. If the latter, the thoroughly settled "red" and other liquors are transferred to a long wrought-iron boat pan, say 30 feet by 8 feet, and 2 feet 6 inches deep in the centre, self-fired, and therein evaporated, and occasionally fished as the salts are deposited. On reaching 70° T., or about 250° F., the pan is cooled down, and thoroughly fished. It is then re-heated to boiling, and say 2¼—3 cwts. nitre added, and when, after continued boiling, a sp. gr. of about 94° T., or a temperature of 270° F., is attained, a little more nitre is introduced (if the previous addition was insufficient), and the whole an hour or two afterwards cooled down, and the clear liquor run into a settler. The salts left behind are washed with a little water (which may be added to the next batch), to free them from nitre, and then removed and drained, to be employed for the manufacture of common caustic ash. The liquor, after being thoroughly settled to removed all salts, is run into a caustic pot. As it is delivered from the shoot it appears of a dark straw colour, and when boiling it gives off ammonia copiously. It is desirable to add all the nitre in the pans, so that it is only occasionally, and in small quantities, used during the finishing operation. The pot is fired carefully till a sample tests 60 per cent alkali, which is the usual strength at which cream caustic soda is sold. The batch is of course not fused, a considerable amount of water remaining in the finished product. Occasionally, but usually through careless firing, the batch assumes a red colour, and as that is an incurable disorder, the whole must just be packed and sold as so much inferior caustic, or fired to fusion and used to make up a batch of white. There are no bottoms in cream caustic, the pots being packed right away till empty.

In manufacturing cream caustic from causticised liquor, very much less salts will, of course, be found. Consequently, specially large fishing pans being unnecessary, the liquor may be evaporated in the ordinary cast-iron boat pans. In other respects the process is the same as that just described.

(To be continued).

New Property of Glycerin.—R. Godeffroy, on examining a chemically pure glycerin from the Apollo Japan Works in Vienna, found that when heated to 150° it took fire, and burnt with a steady, blue, non-luminous flame, without diffusing any odour or leaving a residue. The glycerin had the specific gravity 1·2609. This property enables glycerin of lower specific gravity to be burnt by means of a lamp-wick.—*Ber. d. Deut. Chem. Ges. z. Berlin.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 18th, 1875.

Professor Odling, F.R.S., President, in the Chair.

After the minutes of the previous meeting had been read and confirmed, the names of Messrs. G. A. Keyworth, R. H. S. Spicer, F. M. Jennings, R. Cowper, and J. S. Felton were read for the first time.

The President said he would not detain the visitors, as there was one there who had come to address them that evening who was so eminently qualified to set before them the experimental work of the late Professor Liebig, a genius not unworthy of comparison with the great English philosopher in whose honour these lectures had been instituted. He would therefore at once ask Dr. Hofmann to deliver his lecture "*On Liebig's Contributions to Experimental Chemistry.*"

The Lecturer, after noticing the great value of this tribute of homage to the memory of the immortal Faraday, who belonged not merely to the island of his birth, but to the civilised world, said he had selected as the theme of his discourse a subject so rich in interesting facts and noble lessons as of itself to command attention,—the labours of one of Faraday's most eminent scientific contemporaries, of a master mind like his, Justus von Liebig, the only name fitted to stand on equal terms by that of Faraday. If we consider the vast number and great importance of the chemical facts established by Liebig, we must proclaim him one of the greatest contributors to our science, whilst of organic chemistry he is the very source and fountain head. It was he who was the first to found the great institutions of chemical education; at the University of Giessen, Liebig organised the first educational laboratory. From this country more especially was it that a large number of young chemists thronged to his school, many of whom have since attained the greatest eminence. And to these great services may we not add the inspiration bequeathed to us by his illustrious example? For us and for our successors for years to come, it will be our duty to work not only with Liebig's instruments in our hands, but with his dauntless spirit in our hearts.

Like Faraday, Liebig's labours in abstract science have borne abundant fruit in the useful arts; to mention but a few instances,—the industries of the fatty bodies and of acetic acid, the manufactures of the fulminating compounds, of prussiate of potash, and potassic cyanide. It was not, however, merely incidentally that he benefited the industrial arts; his noble researches in the field of agricultural chemistry will ever associate his name with those of Davy and Lavoisier, the great law-givers of modern agriculture. To Liebig we especially owe our knowledge of the important part played by the saline ingredients,—the ashes of plants,—in their nutrition, and consequently, of the necessity of returning these ashes to the soil, after each harvest, in order to renew its fertility. It was in 1842 that, passing on to the intricate chemistry of animal life, he published his work "On Organic Chemistry in its Application to Physiology and Pathology;" and as an outgrowth of these researches, we may allude to the Food industry, which has already attained such colossal proportions in the southern hemisphere. We must also bear in mind our debt to Liebig for the discovery of chloroform and of chloral,—invaluable agents placed by chemistry at the disposal of medical art.

From among the various fields here presented, it was necessary to make choice of some one, for more detailed examination, and, considering the special pursuits of his hearers, there could be no hesitation; he would ask them to accompany him in a rapid review of Liebig's labours in pure chemistry, but even here he must confine himself to a few illustrations amongst several hundreds. Of these few, the first alluded to, although perhaps not the most

brilliant, was one which had conduced more than any other to the marvellous development of modern chemistry,—the apparatus, so simple and yet so perfect, for the analysis of organic bodies by combustion; the method for determining the molecular weight of bases by the combustion of their platinum salts, and that for the analysis of air by means of an alkaline solution of pyrogallic acid were also Liebig's.

In passing from the analytical methods, and the apparatus devised by this great chemist, to his researches, we find among the first to claim our attention his investigations in the cyanogen group begun by an examination of the fulminates, from which he naturally passed on to the cyanic group at large; then cyanic acid, cyanuric acid, and their salts became successively the object of his abours. It was he who first gave a satisfactory explanation of the processes involved in the preparation of the yellow prussiate of potash by fusing animal matters with potash in iron vessels, the product first formed being potassium cyanide, which then takes up iron during lixiviation. Amongst the interesting and valuable results arising from his investigation of the ferro-cyanides, were the preparation of hydro-ferrocyanic acid, of potassium cyanide, and potassium cyanate. From the cyanates to the sulphocyanates was but a step; and as, in the course of his experiments, he required large quantities of ammonium sulphocyanate, he ultimately found the best method of preparing this to be the treatment of hydrocyanic acid with yellow sulphide of ammonium. This naturally led to the delicate test for hydrocyanic acid by converting it into ammonium sulphocyanide, when a drop of a solution of ferric chloride produces the well-known blood-red colour. After glancing at the benzoyl compounds, the lecturer noticed the importance of the acid chlorides, first obtained by Liebig from the aldehydes, although Cahours's method is now universally adopted in preparing them. These chlorides furnished us with acids, ethers, and amides, a source of new compounds, not shaken by time, but still fresh and fruitful as on the first day of their discovery.

To Liebig and Wöhler are we indebted for the investigation of the properties and the determination of the formula of uric acid. Its liability to change, while increasing the difficulty of the inquiry, enabled these chemists to reap a rich harvest of results such as few have ever gathered from one field of research; the discovery of not less than sixteen new bodies rewarded their labours, and it is noteworthy that only one of these has since disappeared from our science. To them are we indebted for the first analysis and the first exact and complete description of murexide, the precursor of rosaniline.

Liebig's first experiments on alcohol, the action of chlorine upon it, led to the discovery of chloral and chloroform, two compounds now in continual use for the alleviation of human suffering,—an illustration of the practical advantages ever following the pursuit of truth. Of the former compound, in 1868, probably there was not a kilogramme in existence in the whole world; now the factories of Berlin alone produce 100 kilogrammes daily. The object of the investigation of alcohol was to elucidate the constitution of this important compound, and gave rise to that long-protracted contest between Dumas and Boulley, on the one hand, who considered ether and alcohol to be hydrates of olefiant gas, and Liebig, on the other, who regarded them as derivatives of a radical to which he gave the name of ethyl. It ended in a signal victory for Liebig, and a universal adoption of his theory. The new notation, introduced by Gerhardt and Laurent, and so strenuously supported by Odling, far from invalidating Liebig's ethyl theory, has, by the masterly researches of Williamson, brought that hypothesis to its last and finest development. He would remind them, moreover, that Williamson owed to Liebig the very agents he so successfully employed in the solution of this problem, namely, the ethylates of potassium and sodium.

To Liebig, also, we owe the explanation of the formation of acetic acid by atmospheric oxidation. This action takes place in two stages, the first being the removal of hydrogen and the formation of aldehyde, the second the direct oxidation of this to acetic acid. Aldehyde was first made out by this great chemist, who at the same time discovered another compound,—acetal,—scarcely less interesting. It was on this occasion that Liebig first observed the lustrous mirror-like deposit of silver formed on gently warming a slightly ammoniacal solution of silver with a few drops of aldehyde.

The compounds discovered by Liebig, which have been passed in review, are amongst those in most frequent use; the reactions are those most commonly employed in research. Could a more eloquent testimony be borne to the influence which Justus von Liebig has exercised upon the progress of chemical science than that his teachings have become familiar as "Household words."

In conclusion, the lecturer related a touching anecdote of the goodness of heart displayed by this great philosopher, and a parallel instance of the generous goodness of Faraday, saying that "no two grander examples will in any age stand forth more dignified by their intellectual work, more conspicuous for their moral beauty, than those whose great names we have been commemorating this day—

MICHAEL FARADAY;
JUSTUS LIEBIG."

At the conclusion of the lecture, the experimental illustrations of which were admirably performed by Professor McLeod,—

Dr. ODLING said that it devolved upon him, in the name of the Chemical Society, to tender their heartfelt thanks to Dr. Hofmann for the comprehensive but far from exhaustive account which he had given them of Liebig's labours, and at the same time to offer him the Faraday medal. This, he felt sure, would have a twofold value in his eyes,—as a memorial of a great and good man, and as the highest compliment it was in the power of the Chemical Society to pay. In limiting the choice for distribution of this medal in the way it had done, the Society not only avoided the difficulty of merely complimenting one another by distributing it among themselves, but it brought them into personal contact with the leading men abroad. Amongst the numerous obligations which chemists, and especially English chemists, were under to Liebig, there was one which had been omitted, and to which he might, perhaps, be allowed to advert,—the training of a Hofmann. In the succeeding Faraday lectures he hoped they might be as fortunate as they were on the present occasion.

Dr. HOFMANN, in reply, said it was with sentiments of the profoundest gratitude that he received from his hands what he conceived to be the highest honour that could be conferred on him, and cordially thanked Dr. Odling for the affectionate terms in which he had referred to him. "If an investigator were called on to pronounce the name associated with the most glorious scientific conquests, he would unhesitatingly give utterance to the name of Faraday, and you have placed me in possession of the Faraday medal. How greatly is its value enhanced in my eyes by receiving it on the very spot where Faraday himself was wont to give forth his discoveries! Allow me in a few words to allude to the sympathy expressed in the eyes of the chemists around me,—many the faces of old pupils, whose acquaintance has ripened into life-long friendship. I ever remember with affection my early years passed in this generous country,—my happy stay in dear old England."

The lecture, which took place in the Lecture Theatre of the Royal Institution, was attended by a crowded audience, amongst whom were nearly all the leading chemists of this country. His Royal Highness the Prince of Wales was present as a visitor.

The next ordinary meeting of the Chemical Society will be held at Burlington House on Thursday, April 1st. The anniversary meeting is on March 30th.

PHYSICAL SOCIETY.

March 13th, 1875.

Professor J. H. Gladstone, F.R.S., President, in the Chair.

Mr. W. Chandler Roberts read a paper "*On the Electro-Deposition of Iron.*" He referred to the beautiful specimens of electro-iron, the work of M. Eugène Klein, a distinguished Russian engineer and chemist, which were exhibited at the meeting of the British Association at Exeter. In 1870 Mr. Roberts visited St. Petersburg, and had the advantage of receiving from the late M. de Jacobi suggestions which enabled him to deposit iron with much success. He stated that a plate of electro-iron, 150 m.m. square by 2 m.m. thick, was deposited on copper by Herr Bockbushmann in 1846. In 1857 M. Feuquières exhibited specimens of electro-iron at the Paris Exhibition. In England, in 1858, M. Garnier patented his process, termed aciérage, for protecting the surfaces of engraved copper-plates; and in the same year Klein produced the admirable works above referred to. The author then exhibited specimens which he had obtained by Klein's method. The bath consists of a double sulphate of iron, and magnesia of sp. gr. 1·155; the chief conditions of success being the neutrality of the bath and the employment of a very feeble current. Iron so obtained possesses a higher conductivity than any commercial iron (Matthiessen), its sp. gr. is 8·139, and it occludes thirteen times its volume of hydrogen. A tube of the metal deposited on a rod of wax, which was vacuum-tight at the ordinary temperature allowed hydrogen to pass freely at a dull red-heat.

After a brief discussion, Prof. Guthrie described some experiments which he has recently made, with the assistance of Mr. R. Cowper, in continuation of former researches "On Salt Solutions and Attached Water." The main object of these experiments was to ascertain the manner in which mixtures of salts act as cryogens, and to study their combination with water at various temperatures and in various proportions. When two salts, to which either the acid or the base is common, and which do not form a double salt, are mixed in equivalent proportion, the cryogen produced has nearly the temperature due to the salt, which, alone, would produce the greatest degree of cold. Solidification begins at a temperature below the melting-point of the least fusible, and continues at lower and lower temperatures until the temperature due to the other constituent salt is reached. Occasionally a cryo-hydrate, having a constant solidifying-point, has been obtained by mixing in definite proportions salts which are not known to exist in the form of a double salt. In all such cases the solidifying-point of the mixture is intermediate between the solidifying-points of the constituents; and its temperature as a cryogen is also between the temperatures of the constituents when separately used as cryogens. When two salts composed of different acids and bases are mixed, and no precipitation occurs, it is generally considered that *partial* double decomposition takes place, two new salts being formed. It was found that if the salts AX and BY be mixed in atomic proportion, and dissolved in the smallest possible amount of water, a mixture identical with that produced on mixing AY with BX is obtained. The temperature and composition of the resulting cryo-hydrate is the same in both cases. But the temperature never falls as low as the point which could be reached by employing whichever of the salts AX, AY, BX, BY, forms a cryo-hydrate with the lowest temperature. Thus a saturated solution of a mixture of nitrate of potassium and sulphate of sodium solidifies at −5° C. A mixture of nitrate of sodium and sulphate of potassium also solidifies at this temperature. Since the solidifying-point of nitrate of sodium is −17°, this salt cannot exist without partial decomposition taking place in either mixture; for, as has been shown above, its presence would ultimately depress the solidifying-point.

Dr. Rae remarked that these researches are specially interesting in connection with the salts retained by sea-ice. With a view to studying this subject, he has already requested captains of whalers visiting the Arctic Regions to bring home samples of ice of different age, and from various localities.

PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

The following discussion followed the reading of Dr. Dupré's paper on the "Natural Constituents of Wine," which appeared in our last number:—

Dr. Redwood—Dr. Dupré having referred to a certificate of mine relating to wine having been used for advertising purposes, I have no hesitation whatever in saying, that I constantly feel heartily ashamed of seeing my name blazoned forth as it is in connection with the advertisement in question, and I can assure you that its being so used has been no fault of mine. In giving certificates of analyses to persons who are engaged in business, and who, I have every reason to suspect, would be likely to use any report that I might give in the shape of an advertisement, I have always made it an invariable rule to stipulate with them that my certificate is not to be so used. In reference to the case in point, a gentleman called at the Pharmaceutical Society, and upon stating that he wanted an analysis, was referred down to me, and he stated that his object was to get a sample of wine analysed; and I undertook to make the analysis, and stated what my fee was, which is my usual fee in such cases. In due course my report was given. I gave him what I considered to be a fair and good analysis, suitable for the circumstances. His statement to me was that he simply wanted to satisfy his own mind and the minds of his friends that the wine which had been offered to him was a wholesome and good wine. I never was more surprised in my life, than when some months or so afterwards I found this report of an analysis of mine appearing as an advertisement.

Dr. Muter—I should like to ask the opinion of Dr. Dupré as to a process for the detection of foreign colouring matters in wine, on which I have been making experiments in wine lately with a good deal of success. I dare say you know of the method—that of removing the albumen, and afterwards taking a test for the colouring matter in the filtrate from the precipitate.

Dr. Stevenson—I am very glad that Dr. Redwood has had an opportunity of giving the explanation he has given, and of explaining how the trick was played upon him. It is very satisfactory to find that there is such an explanation of the circumstances under which the certificate was given. I think, myself, that we ought to set our faces against such a use of certificates, and especially as medical men, against recommending wines for certain dietetic purposes. Dr. Dupré is perhaps pre-eminent above all in this country and abroad on the subject of wines. He has paid exceeding attention to this subject, and I hope that he will give in his paper, which will appear in print, the whole of the details as to all these facts and figures with regard to wine. They are somewhat difficult, of course, to follow, as they are read out here, but they are so valuable, that I hope he will give as ample details as he possibly can. And as to that very important subject—the ratio of one constituent to another in the wine—I cannot too much express my gratification that we have had such a paper, which will form one of the most valuable contributions to the first number of the Journal of the Society.

Mr. Cleaver—With regard to the presence of tartaric acid in wine, it seems to me that it is almost impossible for so much tartaric acid to be in wine in the state of tartaric acid, as there are potash salts present. They would

WEIGHT IN GRAMMES OF SOME OF THE CHIEF CONSTITUENTS OF 1 LITRE (1000 C.C. OR 1000 VOLUMES) OF THE UNDERMENTIONED WINES.

Particulars of Wines Analysed.	Doz.	Vintage.	Specific Gravity.	Absolute Alcohol.	Free Fixed Acid in Tartaric Acid.	Free Volatile Acid in Acetic Acid.	Total Free Acid in Tartaric Acid.	Real Tartaric Acid.	Total Dry Residue.	Grape and Fruit Sugar.	Total amount of Ash.	Carbonate of Potassium.	Sulphates and Chlorides.	Phosphate and Carbonate of Calcium.	Total amount of Phosphoric Acid.	Alcohol in Fixed Ethers.	Alcohol in Volatile Ethers.	Total Alcohol in Ethers found.	Total Alcohol in Ethers calculated.	Proportion per cent of Alcohol found to Alcohol calculated.
Hock, white	30s.	1862	993·43	95·6	3·48	0·57	4·20	—	18·63	—	1·95	0·58	0·76	0·60	0·32	0·132	0·230	0·362	0·360	100·5
" "	40s.	1859	993·48	92·0	4·20	1·14	5·62	2·550	18·55	0·12	1·70	0·07	0·78	0·85	0·30	0·199	0·239	0·438	0·458	95·7
" "	120s.	1857	992·81	104·4	4·31	0·93	5·37	0·675	20·60	1·12	1·45	0·14	0·46	0·85	0·35	0·225	0·239	0·464	0·493	94·3
Claret	15s.	1865	995·58	85·3	4·24	1·47	6·03	0·675	21·40	4·31	2·08	0·66	0·95	0·48	0·33	0·155	0·197	0·352	0·476	74·0
"	48s.	1865	995·03	120·0	4·24	1·74	6·41	1·875	24·33	2·04	2·25	0·66	1·05	0·55	0·30	0·186	0·248	0·430	0·581	74·6
"	66s.	1861	994·73	85·3	3·23	1·80	5·48	1·838	18·00	0·95	2·00	0·38	0·99	0·63	0·30	0·166	0·216	0·382	0·429	88·8
Hungarian, red	21s. ..	..	992·07	113·6	3·56	2·49	6·68	0·600	20·85	1·47	1·85	0·41	0·91	0·53	0·35	0·151	0·358	0·509	0·656	77·6
" white	34s. ..	..	992·88	95·4	5·33	1·47	7·16	0·675	18·20	0·61	1·75	0·14	0·81	0·80	0·25	0·186	0·271	0·457	0·613	74·5
" "	42s. ..	..	993·09	94·9	4·74	1·80	6·99	0·375	18·13	0 24	1·88	0·12	0·90	0·85	0·25	0·162	0·273	0·435	0·596	73·0
Greek wine "	20s. ..	..	994·56	107·2	3·41	3·00	7·16	0·675	25·30	2·00	2·25	0·07	1·18	1·00	0·25	0·224	0·214	0·438	0·690	63·6
" " "	28s. ..	..	992·25	124·5	4·54	1·68	6·64	—	24·42	1·12	3·05	0·41	2·01	0·62	0·25	0·384	0·179	0·563	0·707	79·6
" " "	36s. ..	..	993·17	138·9	2·33	1·77	4·54	0·300	25·50	3·64	3·75	0·21	2·49	1·05	0·45	0·245	1·207	0·453	0·530	85·1
Sherry	22s.	1865	994·09	172·0	2·70	1·53	4·61	0·187	42·00	25·65	4·50	0·07	3·63	0·80	0·18	0·206	0·216	0·422	0·639	66·1
" high price		1860	997·93	178·1	3·08	1·68	5·18	0·262	53·50	29·70	5·50	0·18	4·41	0·95	0·25	0·290	0·391	0·681	0·749	90·8
" " "		1857	998 30	184 0	2·81	1·62	4·84	0·150	56·44	35·10	5·13	0·07	4·18	0·88	0·13	0·262	0·469	0·731	0·722	101·2
Madeira, E.I.	60s. ..	..	993·94	177·5	3·26	1·68	5·36	0·300	43·47	20·80	3·90	0·27	2·52	1·10	0·42	0·305	0·382	0·687	0·774	88·7
" high pr ce		1813	994·15	180·0	4·20	3·27	8·25	—	45·41	16·29	3·59	0·17	1·93	1·49	0·50	0·460	0·773	1·233	1·207	102·1
Port	32s.	1864	1004·76	185·6	3·08	0·84	4·13	0·225	75·57	43·31	2·48	0·48	1·34	0 65	0·35	0·302	0·128	0·430	0·620	69·4
" high price		1854	997·42	175·3	3·54	1·07	4·83	0·225	53·90	22·84	2·58	0·66	1·37	0 55	0·33	0·351	0·220	0·571	0·697	84·9
" " "		1842	986·95	182·6	2·66	1·08	4·01	0·150	31·01	10·10	2 10	0 69	0·86	0 45	0·33	0·283	0·331	0·614	0·595	103·2
Marsala	16s.	old	996·65	167·1	1·88	1·11	3·26	—	49·83	32·40	2·25	0·21	1·54	0·50	0·18	0·256	0·189	0·445	0·447	99·3
"	20s.	very old	999·65	163·9	2·25	1·38	3·98	0·150	57·48	37·60	3·13	0·55	1·92	0·65	0·23	0·333	0·216	0 549	0·550	99·8

form tartrate of potash, which would be insoluble in the alcohol, and it stands to reason that there would be no tartaric acid present.

Dr. DUPRÉ—Certainly.

Mr. WANKLYN—I should like to say a word about the ash of wine. I believe that, if the ash of most of the wine in this country be examined, it will be found to consist almost entirely of sulphates. A while ago I examined the ash of some Rhine wine, and I found it consisted almost entirely of sulphates. Where wine is not treated with sulphate of lime, it is usually, I believe, treated with sulphurous acid, and we must not expect to find the ash of wine to consist of much else than sulphates.

Dr. DUPRÉ.—I have just a few words to say. First of all, I am very glad that Professor Redwood has given that explanation. As regards the certificates, I must confess that I have never any difficulty about the matter. I have been for many years engaged in the analysis of wine. I have published, in conjunction with Dr. Thudichum, a very large work on wine, and have been very frequently referred to on the subject; but I invariably make it a point to write to the man, whoever he may be, and ask him to give me a written engagement or letter that the analysis should be used only for his own private personal information. I believe that there is nothing which is more detrimental to us as analysts than to see these certificates constantly put forward as a kind of intimation that the profession of the analyst is not quite so high and honourable a one as it might be. I think that, as analysts, we have a very high function to perform on behalf of the public. We have, on the one hand, to ensure that the public gets only a pure article, and, on the other hand, we have to defend the honest trader, that he may not be put into competition with the trader who makes use (to put it mildly) of trade tricks. The certificates are nearly always made use of for such purposes. With regard to the matter mentioned by Mr. Wanklyn, I have stated in the paper, which must of necessity have been a short one, that even pure natural wines frequently contain no chlorides or carbonates, as the wine has been sulphured; but I have always pointed out the great distinction between sulphuring and plastering. The sulphuring increases the sulphuric acid, but not materially the ash; but plastering increases not only the sulphates but the ash, simply because the one is done only to finished wine. It leaves sulphuric acid, and it leaves the cream of tartar of natural wine just as insoluble as it was before. The cream of tartar is thrown down, whereas the sulphuring which is done to the must changes the cream of tartar into sulphide of potassium. With regard to the question asked by Mr. Cleaver, it is almost invariably the case that the tartaric acid present in a wine is present as bitartrate of potassium, and the amount is nearly always proportional to the solubility of the bitartrate in the wine at the lowest temperature to which that wine may have been subjected; so that if the wine had been exposed to cold, it would contain less acid than before. I have frequently had from Spain samples of acid wine, which have been exposed during winter here, and which gave a considerable deposit of bitartrate of potassium. Such a wine, of course, afterwards contains less bitartrate; but that is not always the case. I have found some wines in which there was a considerable excess of bitartrate as measured. It appears that the riper the grape, generally speaking, the greater is the amount of tartaric acid contained in it. In conclusion, I have been extremely glad to hear the explanation of Dr. Redwood that he objects as strongly as I always object to these certificates.

Dr. Dupré then handed in the table inserted above, showing the proportions of the constituents of the various wines referred to therein.

WE have just perused with considerable interest the Thirteenth Annual Report on "Unsound and Adulterated Food," presented by Dr. Cameron, Public Analyst for Dublin, to the Lord Mayor and Corporation of that city.

It appears that during the year 1874 Dr. Cameron analysed 385 samples, of which he found no less than 220 to be adulterated. This proportion (being about 62 per cent) strikes us as being remarkably high, as compared with the general results in England, and it is perhaps worth noting that Dr. Cameron's analyses in Ireland in 1874 disclose just about the same proportion of adulteration as did the investigations of Dr. Hassall in England in the years 1851 to 1854.

As in most other places, milk appears to be in Dublin the article to which the adulterators devote the greatest attention. Dr. Cameron examined 232 samples, and

only found 65 of them pure. Mustard, too, seems to be subject to much sophistication, as of 31 samples 22 were mixed with various foreign substances, cayenne pepper being used to give pungency. Amongst other articles, Dr. Cameron analysed coffee, tea, cocoa, sugar, pepper, soda, confectionery, bread, brandy, whisky, wine, and porter. Strange to say, Dr. Cameron finds no adulteration in the article of butter. In this respect, he is more fortunate than most analysts on this side the Channel have been, as butter in England has not been found remarkable for its purity; and we fear that in some cases we have been guilty of the injustice of crediting our Irish friends with sending us some of the worst samples.

Thirty-seven prosecutions were instituted under Dr. Cameron's certificates, all of which were successful, the total amount of fines imposed, with costs, being £150.

Dr. Cameron supplements his report with a list of the names and addresses of the persons convicted, and the amounts of the individual penalties. He also adds some remarks on the Bill now before Parliament, in which he animadverts on some of the defects to which we have repeatedly called attention. Amongst other things, Dr. Cameron objects to the "exception" which allows of the sale of mixtures which are the subjects of patents, and he says:—"A patent has been taken out for converting chicory-root into a form in which it simulates the appearance of coffee-berries; and, consequently, if the Bill become law, such spurious coffee-berries may be legally vended. Another patent has been taken out for the purpose of mixing coffee and chicory, and I am aware that the mixture has been largely sold under the name of patent coffee."

We gather from Dr. Cameron's figures that adulteration, since the passing of the Act of 1872, has been on the decrease in Dublin; but it is still so extensively practised that we can only wonder to what proportions it might have grown if the original intention of the Government to confine the operation of the new Bill to England had been adhered to.

The "Sale of Food and Drugs Bill," which has been twice recently on the order-paper of the House of Commons, has on both occasions been postponed, and cannot now come on for consideration till after the Easter holidays.

MILK AND THE ADULTERATION ACT.

At the Society of Arts, on the 17th inst., Mr. Wanklyn delivered a lecture with the above title. The lecture consisted, first, of a *resume* of the usual process of milk-analysis as described in his well-known little book on that subject, and, secondly, of a criticism on the present Adulteration Bill now before the House of Commons.

We noticed the following novelty, or at any rate a novel mode of statement, in the course of the lecture. The lecturer said that whole milk, skim-milk, and cream exhibit only one point of analytical difference, they contain different proportions of fat; but the ratio between the water in them and the "solids not fat" is the same, viz., 90·09 : 9·65. The practice of watering is recognised by the alteration of this ratio. Mr. Wanklyn proposed that the milk-trade should adopt the term, half-skim, and openly sell milk under that designation. In Switzerland, half-skim is recognised and sold.

NOTICES OF BOOKS.

Cholera: How to Prevent and Resist it. By Dr. Max von Pettenkofer, President of the Sanitary Commission of the German Empire. Translated by T. W. Hime, A.B., M.B., &c. London: Baillière, Tindall, and Cox.

The translator, in his introduction, reminds us that each time the cholera has visited Europe, it has shown a greater reluctance to depart. Since 1865, it has occurred to a greater or less extent in various parts of Europe; and though England has, so far, escaped, there is no knowing how long this immunity may continue.

Yet, with such a prolonged warning before our eyes, we are taking scarcely any steps to avert or even diminish the danger of an attack. Our sanitary knowledge, imperfect as it is, is still far in advance of our practice.

Dr. Pettenkofer's work calls attention to certain points bearing upon public health which have been generally overlooked. We are by this time alive to the importance of keeping our houses well ventilated. We have heard, also, much discourse,—partly rational, but partly foolish, exaggerated, and sensational,—anent our water supply; and through the mistaken kindness of the Registrar-General we have become familiar with the awful and misleading notion of "previous sewage contamination." But the general public assume, in Dr. Hime's words, "that the atmosphere ends where the ground begins." Professor Pettenkofer's great merit as a sanitary authority consists in his having pointed out, and proved by striking experiments, that the soil or ground on which our houses are built is pervaded by air and water. "A very compact gravel will consist of pores or air-holes to the extent of one-third of its bulk. . . . New well-baked bricks will absorb (each) as much as half-a-pint of water; a compact sandstone suitable for building purposes will, in a short time, absorb from five to six times of its own weight of water." That air when rarefied by a rise of temperature tends to ascend is, of course, a familiar fact. During the greater part of the year our houses are at a higher temperature than the external atmosphere. Consequently, they act as chimneys, or ventilating-shafts, through which the air in the ground under and around their foundations will rise upwards. If such air is tainted with the emanations of cesspools, grave-yards, sewers, and putrescent organic matter generally, the consequences to the health of the inmates are self-evident. The evil is further intensified by the fact that the outside ground immediately adjacent to houses is often rendered air and water-tight by a coating of asphalte. In this case, the soil under the house offers less resistance, and naturally becomes the course of the upward current. This evil might, we think, be very much diminished if all ground under houses and all the subterranean walls were likewise well cemented with asphalte, or some similar body.

Along with "ground-air" we have to deal also with "ground-water." The conclusions arrived at by the Cholera Commission of Bavaria, in 1854, were "that epidemic cholera only occurred in places situated on porous ground, permeable to air and water, and in which water could be found at a moderate depth, and that places situated on impermeable soil (rock, &c.), were not visited by cholera at all, or only in isolated cases." "A clay soil resting on limestone gravel, through which the water never rises sufficiently high to reach the clay, is unsusceptible to cholera, a fact which has been often noticed in different places, as well as in Munich during the epidemics of 1836 and 1854. In Munich, Haidhausen, and Berg, the epidemic of cholera confined itself to the houses situate on the gravel, and avoided in the most striking manner those on the more elevated clay." This law which, of course, applies as well to typhoid and other zymotic diseases, accords ill with the preference so heedlessly given to gravel soils as the supposed best locality for dwellings. True, a gravel soil, if perfectly unpolluted, and if not traversed by currents of foul water, has its sanitary advantages. But how rarely are such conditions fulfilled, especially in urban and suburban localities!

The following passage calls for the most serious attention of sewage irrigationists and of "intermittent downward-filtrationists:"—"The soil has a certain power of rendering decomposing substances harmless, but, like everything else, this has a limit."

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We feel sure that every attentive reader of this work will agree with us in pronouncing it a most valuable contribution to sanitary literature.

CORRESPONDENCE.

DISSOCIATION OF NITRIC ACID.

To the Editor of the Chemical News.

SIR,—Allow me space to correct an error in the report of the paper on "Dissociation of Nitric Acid," read before the Chemical Society on the 4th inst.

In the third series of experiments it is stated that nitric acid containing nitrous acid was *not* decomposed on boiling, the reverse being the case. Nitric acid containing 0·123 per cent of N_2O_3 yielded 0·3 c.c. of gas, that containing 1·28 per cent yielded 2 c.c. of gas of which 71 per cent was oxygen; but nitric acid containing no nitrous was boiled to dryness without any decomposition occurring.—I am, &c.,

PHILIP BRAHAM.

6, George Street, Bath,
March 17, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 7, February 15, 1875.

New Researches on the Mode of Intervention of Electro-Capillary Forces in the Phenomena of Nutrition.—M. Becquerel.—Desirous of ascertaining the physico-chemical action exerted by water and salt-water upon tubers and fruits, the author has made several series of experiments, which lead to the following results:—Water is constantly positive, and the fruit or the tuber negative, which indicates that the electro-capillary currents have the effect of oxidising the parts under the epidermis or the skin. With saline water the result is inverse. We see hence the effects which may be produced in living bodies by the introduction of different liquids, effects which should be taken into consideration in the application of the physico-chemical sciences to medicine.

Depth and the Superposition of the Magnetised Layers in Steel.—M. J. Jamin.—The magnetic strata are limited to a certain thickness, which they can never exceed. This limit varies in different steels. It is very great in those which are soft, and diminishes as the proportion of carbon augments and as the temper is harder. For certain bars which the author has studied it is $=0^m4$; but he has specimens where it is below 1·10 m.m. The latter only receive what might be called a superficial magnetic coating, the thickness of which it is not possible to augment by increasing the intensity of the current. But if the depth of the magnetisation diminishes along with the magnetic conductibility, the intensity of the magnetism increases. It follows that the quantity of magnetisation is subject to two causes of inverse variation—the depth which increases, and the intensity which lessens as the conductivity increases.

Certain Mechanical Properties of Saturated Steam.—M. C. Antoine.—Between the temperature, the tension, and the volume of steam we may establish certain relations of great simplicity. If we designate the temperature of the steam in degrees C by t; the maximum elastic force of the steam, in atmospheres, by p; the same elastic force expressed in centimetres of mercury by F; and the volume of a kilogrm. of steam in litres by V, then—

(1.) $pV^{1,1}=3538$.

(2.) $pV=135\sqrt{c}+55$.

If we calculate the temperatures, setting out from 55° below the zero of melting ice we have, on designating these new temperatures by T,—

(3.) $PV=135T^{\circ},50$.

The elimination of V from the equations 1 and 3 gives—

(4.) $P=\left(\frac{T}{155}\right)^{5,5}$ and $F=76\times P=(0{\cdot}014175\times T)^{5,5}$

The elimination of P in the equations 1 and 3 gives—

$$V=\left(\frac{685{\cdot}8}{T}\right)^5 \text{ or } V=0{\cdot}1517\left(\frac{1000}{T}\right)^5.$$

Bulletin de la Societe Chimique de Paris, No. 1, January 5, 1875.

Action of the Chlorides of Alcoholic Radicals on the Secondary Monamines.—M. Ch. Girard.—Allow to react in cast-iron enamelled autoclaves, or in tubes, for ten to twelve hours at 200° to 250° C., 100 kilos. diphenylamin, hydrochloric acid (sp. gr. 1·17) 68 kilos., and pure methylic alcohol 24 kilos. The pressure may amount to 10 to 15 atmospheres. The mixture when cold is decanted, treated with soda, and distilled. The methyl-diphenylamin which distils over is still contaminated with a little diphenylamin, which is removed by treatment with twice the volume of concentrated hydrochloric acid and agitation. The mass becomes hot, and on cooling deposits hydrochlorate of diphenylamin in crystals. These are thrown on a filter, and the liquid hydrochlorate of methyl-diphenylamin is decomposed with water, and then neutralised with soda. The boiling-point of the purified methyl-diphenylamin is 282° C. To prepare ethyl-diphenylamin, 30 to 32 kilos. of ethylic alcohol are used instead of the methylic directed above, the proportions of diphenylamin and of acid remaining the same. It is an oily liquid, and distils over at about 295° to 297°. It is coloured violet by nitric acid, and forms a crimson solution in water. It yields dyes with many oxidising agents. Amyl-diphenylamin is prepared and purified like its two lower homologues. It is likewise of an oily consistence, and distils at 330° to 340°. Nitric acid produces with this base a blue-slate colour, resembling that given by diphenylamin. All these bases can be transformed into blue dyes by heating with oxalic acid from 120° to 130° for fifteen to twenty hours. The yield of colour is very abundant. The tinctorial bodies formed are freed from excess of base by successive treatment with benzol, ether, petroleum, and alcohol, in which last liquid these blues are unfortunately very sparingly soluble. Pure diphenylamin is also converted into a blue dye by the same treatment, as proved in 1866 by the author and M. de Laire, and may be purified in the same manner. It is more soluble in alcohol than the blues produced from the tertiary monamines. These dyes may, however, be obtained in a state soluble in water by heating either diphenylamin or the tertiary monamines with a mixture of oxalic and sulphuric acids, at temperatures not exceeding 140°. The soluble blue dye, thus prepared, is easily freed from any excess of base. Advantage is taken of the different solubility of the calcareous salts of the sulpho-conjugated acids produced in the reaction, those of the blue compound not having the same properties as those of the secondary and tertiary monamines. The sulpho-conjugated acids of diphenylamin readily reproduce this base.

Action of Chlorine on Perbromide of Acetylen.—M. E. Bourgoin.—The final result is the same whether these substances are allowed to react in sunlight or in darkness: the hydrogen and half the bromine are replaced by chlorine.

New Treatment of Commercial Nickel so as to obtain a Pure Sulphate of Nickel, without the use of Sulphuretted Hydrogen or of Ammonia.—M. A. Terreil.—The salts of nickel employed in the electro-deposition of that metal are prepared from commercial nickel, which is an alloy of nickel, copper, and iron, with traces of arsenic, containing from 40 to 90 per cent of actual nickel. The author's process consists of four operations—solution of the crude metal in acids; precipitation of the copper by iron; peroxidation of the iron, and conversion of the metals into sulphates; precipitation of the iron by carbonate of baryta, and crystallisation of the sulphate of nickel. The nickel is first dissolved in seven to eight times its weight of aqua regia; the solution is evaporated almost to dryness; the residue is re-dissolved in water, using about five times the weight of the nickel employed. A little arseniate of iron remains insoluble, and is removed by filtration. Metallic iron, preferably small nails, is introduced into the hot liquid, to about the weight of the nickel employed. It is stirred from time to time to detach the copper from the iron. As soon as a piece of bright iron, introduced into the liquid, is no longer coated with copper, this process is complete. The whole is thrown on a filter, and washed repeatedly. The copper is then collected by sifting it under water, in a sieve coarse enough to let pass the coppery metallic powder, but retain the iron. The copper is dried, and is then marketable. The filtrate now contains merely nickel and iron. The latter is peroxidised, either by a current of chlorine, or by treatment with nitric acid. Sulphuric acid at 66° B. is then added in the proportion of 2 parts to 1 of nickel employed, and the whole is evaporated to dryness to expel nitric and hydrochloric acids. The dry residue is re-dissolved in water, a part sometimes remaining insoluble, consisting of sub-sulphate of iron. From the solution the iron is thrown down by means of carbonate of baryta (artificial precipitated). This carbonate separates the iron as sesquioxide, and forms at the same time insoluble sulphate of baryta, without acting upon the sulphate of nickel. The last traces of arsenic are thrown down along with the sesquioxide of iron. The precipitation is effected by gradually adding a slight excess of carbonate of baryta to the liquid, slightly heated, but not so as to exceed 50° to 60°. It is complete when a further addition of carbonate occasions no effervescence, and does not become covered with peroxide of iron. Pure sulphate of nickel then remains in solution. It is separated from the precipitate by filtration, and the filtrate is evaporated till a pellicle appears on the surface, when it is set aside to crystallise.

Reaction of Bromide of Ethylen on Dilute Alcohol in Presence of Acetic Ethers of Glycol.—M. E. Demole.—Not adapted for abstraction.

Determination of Albumen by Tannin.—The determination of albumen by a standard solution of tannin does not give correct results, since all kinds of albumen do not combine with the same proportion of the reagent. Thus, that found in Bright's disease retains 37 per cent of tannin, but that met with in accidental cases of albuminuria, only 28. To determine albumen by means of tannin, it is necessary to add to the albuminous liquid, half its volume of a solution containing 26 per cent of common salt. Solution of tannin is added till all the albumen is thrown down. The whole is filtered, washed with water till free from salt, the tannin removed by means of boiling alcohol, and the residue dried and weighed.

Preparation of Magenta without Arsenic.—M. Bibanow.—The author has tried Nicholson's process, heating 3 parts of aniline (quality for red) with 1 part of hydrochloric acid at sp. gr. 1·16, and 1 part nitric acid at sp. gr. 1·42, to 180° to 200°. The result was not satisfactory, the mass quickly turning to a dirty violet. He next tried double salts of heavy aniline and of chloride of zinc. The experiment was made with a mixture of 120 grms. of heavy aniline; 100 of hydrochloric acid at 1·16; 30 grms. of nitric acid at 1·43; and 90 c.c. of zinc chloride in solution (1 grm. of zinc in 1·5 c.c.), heated to 186°. In this case, also, the result was a dirty violet. The author then treated the double chloride of pseudo-toluydin and zinc with nitrate of aniline, heating to 140° to 160° with a little free aniline to promote fusion. The proportions were—

8 parts $ZnCl_2,2(C_7H_9N)$,
1 part $ZnCl_2,2(C_6H_7N)$,
6 parts C_6H_7N,HNO_3.

The results were satisfactory as to shade, but the author could not fix the yield. 20 grms. of nitranilin, with 10 grms. pseudo-toluydin, and 5 of aniline, yielded also a magenta of fine tone, but in small quantity.

Quantity of Neutral Fatty Bodies Remaining in Fats after Saponification.—M. Birnbaum.—Fats are saponified industrially either by water under pressure, or by dilute sulphuric acid in open vessels. The quantity of neutral fat remaining after industrial saponification is estimated by the quantity of glycerin set free by the action of caustic potash. An indigenous tallow, heated with water for ten hours at 14 atmospheres, and then saponified with potash, yielded 0·094 of glycerin in 8·355 parts, corresponding to the following percentage composition:—

Water	0·26
Neutral fats	10·90
Free fatty acids	88·57
	99·73

A grease from New York, treated seven hours at 14 atmospheres, and then re-treated, gave—

	First Treatment.	Second Treatment.
Water	0·38	0·11
Neutral fats.. ..	14·37	13·08
Free fatty acids ..	85·17	86·11
	99·92	99·30

The results obtained by saponification are much more perfect, as shown by the following analysis of a grease thus treated:—

Water	0·12
Neutral fats (?)	99·53
Ash..	0·03
	99·68

Preparation of Colourless Crystalline Carbolic Acid.—M. Schnitzler.—Raw phenate of soda is strongly heated in a copper still. Water, naphthalin, oils, and a little carbolic acid pass over, and the fire is removed when the distillate begins to run milky: 15 kilos. require about ten hours. The greater part of the carbolic acid remains combined with the soda as a solid mass. The temperature of the vapour, during distillation, may reach 170°. The solid residue is afterwards dissolved out in triple the quantity of water necessary. This liquid is allowed to settle for some days, when certain impurities are deposited. Dilute sulphuric acid is then added to the clear liquid, the carbolic acid is decanted and distilled in glass vessels. Water passes over first, then pure carbolic acid, which crystallises entire; and, lastly, a less pure carbolic acid, which, even after crystallisation, retains some oily impurities.

Reimann's Farber Zeitung, No. 4, 1875.

This number contains an article on the prejudice against green tarletans, which, as non-technical papers assert, are got up with Schweinfurt green—a powerful poison. The editor shows that this arsenical preparation is now superseded by Guignet's green, which is perfectly safe.

There are receipts for a green for calico; for dyeing felts; and for a logwood blue on cotton yarns.

Burning petroleum can be extinguished by adding to 1-60th part of chloroform.

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No. 5, 1875.

Dyers in Berlin and other parts of Germany complain of the stringent regulations of the sanitary police. They are compelled to run their effluent waters into large tanks and to purify them with lime—a process which certain experts have pronounced impracticable upon the large scale.

Manufacture of Alizarin.—The manufacture of alizarin has hitherto been checked for want of the raw material, since anthracen, which is converted first into anthrachinon and then into alizarin, is found only to a small extent in coal-tar. There is now a prospect of obtaining the raw material in quantity. Phthalic acid, $C_{16}H_4O_6$, is produced by oxidising naphthalin. Benzol, $C_{12}H_6$, is well known to be an abundant constituent of coal-tar. If the chlorine compound of phthalic acid, $C_{16}H_4O_4Cl_2$, is heated for twelve hours with benzol to 220° C. in a closed vessel, anthrachinon is obtained according to the following reaction:—

$$\underbrace{C_{16}H_4O_4Cl_2}_{\text{Phthalic Chloride.}} + \underbrace{C_{12}H_5H}_{\text{Benzol.}} =$$

$$\underbrace{C_{28}H_8O_4}_{\text{Anthrachinon.}} + \underbrace{2HCl}_{\text{Hydrochloric Acid.}}$$

This process is proposed by Piccard, and will, it is hoped, soon be introduced into practice.

There are receipts for printing a green and white pattern on a dark blue ground; for a finish for cottons; and a bright reddish blue on wool, in two methods.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved process for the preservation of meat, fish, and other articles of food, and similar perishable substances. Claudius Stibbard Clark, Hind Street, Poplar, Middlesex. May 23, 1874.—No. 1837. The said invention relates to the preservation of meat, fish, poultry, game, and other articles of food, and similar perishable substances by treating them with a liquid or solution of bisulphite of lime, limestone crystallised sugar or other saccharine matter, saltpetre, and common salt.

Improvements in the production of nitric acid. Eustace Carey Prentice, of the firm of Prentice, Brothers, Stowmarket, Suffolk. May 25, 1874.—No. 1841. This invention consists, first in the admixture and incorporation with the nitrates, such, for example, as the nitrate of soda, or with nitrate of potash, to be decomposed by means of sulphuric acid for the purpose of effecting the production of nitric acid, of oxidising agents; such, for example, as the chlorates. Chlorate of potash, for example. Permanganates or manganates of the alkalies, or of the alkaline earths, or the peroxides; for example, the peroxide of manganese Chromic acid, the chromates and the bichromates of the alkalies and of the alkaline earths, and of such metallic oxides and compounds as shall, by the action of sulphuric acid and by the presence of the lower oxides of nitrogen, be capable of elevating the same from a lower to a higher degree. Secondly. Or instead of adding to the nitrates either of soda, potash, or lime the whole or a portion of the oxidising agents necessary to convert the lower oxides of nitrogen into the higher oxides or into nitric acid, I add such oxidising agents to the sulphuric acid to be employed for effecting the decomposition of the nitrates, and employ such admixture for effecting the decomposition of the nitrates, and for the production of nitric acid. Thirdly. The employment of oxygen in a pure or in a concentrated form, such, for example, as that obtained by the heating of peroxide of manganese and chlorate of potash, in admixture with the products which are evolved in the production of nitric acid from nitrates by the action of sulphuric acid upon the same. Fourthly. The employment in the production of strong nitric acid of an intermediate or secondary vessel containing sulphuric acid, in conjunction with any of the before-mentioned oxidising agents, so as to effect the conversion of the lower oxides of nitrogen into the higher, and thereby increase the yield of the nitric acid. Fifthly. The employment of any of the before-mentioned oxidising agents in conjunction with nitric acid, containing the lower oxides of nitrogen, so as to convert the same into the higher oxides, or into nitric acid. Sixthly. The treatment by the admixture of any of the before-mentioned oxidising agents, of a mixture of nitric acid and of sulphuric acid resulting from the production of gun-cotton or from other sources, such acids containing organic or other matters or compounds as cause the decomposition of the nitric acid upon the application of heat.

Improvements in the manufacture of artificial yeast-powder and prepared flour of a self-raising character. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Edward Peers Eastwick, New York, U.S.A.) May 26, 1874.—No. 1846. This invention consists in the manufacture of a new compound to be used in connection with any kind of flour or amylaceous matters intended for culinary purposes. The said compound or mixture is composed of neutral and acid salts in the proportion and for the purpose hereinafter more fully specified. The chemicals which may be used are the carbonates (acid or neutral) of the alkalies and alkaline earths, soda, potassa, ammonia, lime, &c., and the neutral or acid or double sulphates of alumina (alums), or any other salts which by their decompositions precipitate alumina, and by which alums may be formed, and sulphates (of the carbonate used) and free carbonic acid gas are produced. A mixture of two or more carbonates and a sulphate or other salt of alumina can be used, and will give a similar reaction as when only one carbonate is used.

Improvements in ebullioscopes. Alexander Melville Clark, patent agent, Chancery Lane, Middlesex. (A communication from Pierre Marie Edouard Malligand, and Marie Euphrésine Elizabeth Brossard-Vidal, both of Paris.) May 29, 1874.—No. 1885. This invention relates to various improvements in instruments known as ebullioscopes, or ebullition alcoholometers. (1) To maintain the liquid in a constant condition during the whole time of testing. (2) To provide means for reading off the mercurial column with greater precision. (3) To verify the accurate calibration of the thermometer. (4) To provide an accurately calibrated mercurial thermometer. (5) To a method of graduating ebullioscopes of any description. (6) To heating the ebullioscope in detail, instead of directly, so as to obtain perfect regularity [in the boiling-point of each liquid*]. (7) To provide a deflector for preventing the tumefaction of the alcoholic liquids during their ebullition. (8) To immerse the bulb of the thermometer in the steam of the boiling water instead of in the water itself, so that the latter may not affect the result.

Improvements in the treatment of phosphates of lime, and in the production of valuable products thereby. Benjamin Tanner, F.C.S., North Strand, Dublin. June 2, 1874.—No. 1915. This invention consists in certain improvements in the treatment of phosphates of lime whereby valuable products are obtained in an economical manner, and of such character and composition as may be desired. Any of the ordinary forms of phosphate of lime of commerce, or any other form of phosphate of lime, or any mixture thereof, is or are heated with hydrochloric acid, and solutions thereof obtained. The solutions obtained as before mentioned are treated with sulphuric acid in such quantity as to combine with the whole or any part of the lime or calcium in the solution, whereby the latter is precipitated in the form of sulphate of lime, and then separated by known means. The liquid portion is again employed as a solvent for the phosphate of lime, and the treatment with sulphuric acid repeated, the lime or calcium removed, and the liquid portion again employed as a solvent for phosphate of lime, the resulting solution being evaporated in furnaces. The relative proportions of lime or calcium and phosphoric acid having been ascertained, sulphuric acid is added to the mass, so as to leave, approximately, for every 71 parts of phosphoric acid 28 parts of lime or 20 parts of calcium. The dry product is useful as a manure. Instead of employing sulphuric acid as before mentioned, either of the alkalies, or their salts in conjunction with sulphuric acid, may be employed. The dry product will contain, in addition to the phosphate of lime, salts of the alkali or alkalies. Phosphoric acid of any desired degree of concentration is obtained according to the number of times the acid liquor is caused to dissolve any of the forms of phosphate of lime, and is subsequently mixed with sulphuric acid in such proportion as to combine with the whole of the lime or calcium present, and the solution may be treated with alkalies or alkaline salts. The character and composition of the products are regulated by the proportions of the phosphate of lime and the acids, alkalies, and alkaline salts.

Improved apparatus for extracting greasy and fatty matters from various waste substances. William Edward Newton, civil engineer, Chancery Lane, Middlesex. (A communication from Frederick William Ralph, Brussels, Belgium.) June 4, 1874.—No. 1951. The object of this invention is to produce a simple and inexpensive apparatus in which bisulphide of carbon may be used for dissolving out and extracting fatty and oleaginous matters from various waste substances, such as cotton-waste, which has been used for wiping and cleaning machinery from the oil that will become spilled thereon The apparatus which forms the subject of the present invention is so constructed and arranged that the escape of the bisulphide of carbon is practically impossible; and when it has been separated by distillation or otherwise from the fatty matters, it can be used over and over again.

MEETINGS FOR THE WEEK.

Tuesday 30th.—Civil Engineers, 8.
Wednesday, 31st.—Society of Arts, 8.
Thursday, April 1st.—London Institution. 7.
—— Chemical, 8.
Friday, 2nd.—Geologists' Association, 8.

TO CORRESPONDENTS.

W. Greaves.—(1) Girard et de Laire's book is not published in English; (2) the Chemical News is the only journal likely to contain information on the subjects you name.

W. L.—Your "Solar Speculations" are mere speculations, with no proof or authorities. What reason have you for saying that heat and gravitation are convertible into one another?

M. L.—Our rule is not to insert letters unless we know the writer's name and address.

* The words "in the boiling-point of each liquid" are found in the copy of the Abridgment delivered by the applicant, but do not appear in the original Abridgment.

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THE CHEMICAL NEWS.

VOL. XXXI. No. 801.

ON THE LIQUATION, FUSIBILITY, AND DENSITY OF CERTAIN ALLOYS OF SILVER AND COPPER.*

By W. CHANDLER ROBERTS, Chemist of the Mint.

THE author states that the most remarkable physical property of silver-copper alloys is a molecular mobility, in virtue of which certain combinations of the constituents of a molten alloy become segregated from the mass, the homogeneous character of which is thereby destroyed. These irregularities of composition have long been known, and reference is made to them in the works of Lazarus Erckern (1650), and of Jars (1774). A very complete memoir was published in 1852 by Levol, who did much towards ascertaining the nature and defining the limits of this molecular mobility. He discovered the important fact, that an alloy containing 71·89 per cent of silver is uniform in composition. Its chemical formula (Ag_3Cu_2) and peculiar structure led him to conclude that all other alloys are mixtures of this, with excess of either metal.

The electric conductivity of these alloys was studied in 1860 by Matthiessen, who doubted the accuracy of Levol's theory, and viewed them as "mechanical mixtures of allotropic modifications of the two metals in each other."

The author then described the experiments he made with a view to determine the melting-points of a series of these alloys. He adopted Deville's determination of the boiling-point of zinc (1040° C.) as the basis of the inquiry, and ascertained by the method of mixtures the mean specific heat of a mass of wrought-iron between 0° C. and the melting-point of silver, which, as Becquerel showed, is the same as the boiling-point of zinc.

The mean of three experiments, which were closely in accordance, gave 0·15693 as the specific heat; and it should be pointed out that this number includes and neutralises several errors which would affect the accuracy of the subsequent experiments.

The melting-point of each alloy was then determined by plunging an iron cylinder into it and transferring the iron to a calorimeter. These melting-points varied from 840° C. to 1330° C., or through a range of 490° C. The alloys which occupy the lowest portion of the curve contain from 60 to 70 per cent of silver. The results are interesting, as they show that the curves of fusibility and electric conductivity are very similar.

The author states that, in studying the phenomena of liquation, the alloys were cast in red-hot moulds of fire-brick in which the metal (about 50 ozs.) could be slowly and uniformly cooled. The results showed that the homogeneity of Levol's alloy is slightly disturbed by this method of casting; and, on the other hand, that alloys which contain more than 71·89 per cent of silver hardly shows signs of rearrangement, when the solidification is gradually effected. Two alloys were examined, which contained 63·0 and 33·3 per cent of silver respectively. Both were found to be far from homogeneous. In the case of the former the arrangement was influenced by gravity, the base of the casting being rich in silver.

The density of pure silver and of Levol's homogeneous alloy, while in the fluid state, were then determined by the method described by Mr. Robert Mallet†; the metals being cast in conical vessels of wrought-iron. The results obtained were as follows:—

	Density fluid.	Density solid.
Pure silver	9·4612	10·5700
Levol's alloy	9·0554	9·9045

In the case of silver, the mean linear expansion deduced from this change of density is 0·00003721 per 1° C., which is nearly double the coefficient at temperatures below 106° C.

* Abstract of a paper read before the Royal Society.

† *Proc. Roy. Soc.*, vol. xxiii., p. 209.

REDUCTION OF METALLIC OXIDES BY HYDROGEN, AND APPLICATION TO THE DETECTION AND QUANTITATIVE DETERMINATION OF METALS.

By W. MÜLLER.

IN a previously published series of experiments (*Poggendorf Ann.*, 136, p. 51), I have shown that the reduction of the oxides of platinum, gold, silver, mercury, copper, lead, antimony, arsenic, tin, nickel, cobalt, iron, and manganese, by means of hydrogen, depends on the temperature, in so much that each oxide is acted upon by hydrogen from a certain degree of heat upwards. This degree was found constant in all experiments with one and the same oxide, but differed for every metallic oxide examined. Even the modications of certain oxides, in case of tin and mercury, could be thus distinguished. In connection herewith, I have tried how far it is possible, by maintaining the temperature at a certain point, to determine quantitatively the ingredients of a mixture of metallic oxides. As previously, the reduction was performed in an elbow-shaped tube, the shorter and fused-up limb of which contained the oxide, and was heated in a sand or paraffin bath; whilst the other open limb was plunged into water or mercury. The disappearance of ½ c.c. of hydrogen, equivalent to less than 0·2 milligrm. oxygen, could thus readily be observed. In all the oxides the remarkable fact was perceived that after some time—in one case, *e.g.*, after an hour—the reduction was manifestly slackened, so that in spite of the much smaller quantity of oxide now present, a distinctly smaller percentage of oxygen was given up to the hydrogen in the same time. This retardation of the process of reduction is not caused by a molecular change of the oxides in consequence of the heat, since prolonged application of heat previous to reduction is without influence on the duration and course of the process. Nor is it due to a change in the hydrogen, for a bulb-tube containing the oxide, and continually traversed by fresh hydrogen, showed the same reaction. Nor does it spring from the particles of reduced metal mixed with the oxide, since oxide of mercury, whose metal is deposited away from the oxide, shows the same phenomenon. As a higher temperature is not required for removing the last residue of oxygen, I was led to the supposition that, with the same absolute distance of oxygen and metal in the oxide, the reduction-movement of adjacent particles produced a new arrangement of the two elements which hinders the action of hydrogen gas. This phenomenon is of more general occurrence. According to the observation of L. Bell (CHEMICAL NEWS, vol. xxiii., pp. 258, 267), the reduction of metallic oxides by carbonic oxide takes a similar course. H. Rose, in his "Manual," when speaking of the separation of cobalt and manganese by reducing chloride of cobalt with hydrogen gas, refers to the difficulty of completing the reaction. In the behaviour of zinc, copper, tin, lead, and mercury, when heated in the air, the difficulty of converting the last traces of metal into oxide seems to be a kindred phenomenon.

Since the reduction takes up a long time, it was necessary to examine whether by prolonged heating of oxides even below their reduction-point, a perceptible quantity of hydrogen might not be taken up. Oxide of copper was heated for 14 hours, 50° below that temperature, and oxide of lead for several days, 100° below the point, in contact with hydrogen, without any action. At this temperature, therefore, the oxides may be regarded as undecomposable. If heated up to a temperature near the reduction-point, and observed for an hour, a decrease of

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the hydrogen was observed, augmenting more and more as the temperature rose. Since, however, an important action only takes place at the point of reduction, the determination of oxides, according to the proposed method, remains practicable, and the examination of the several determinations was undertaken.

The mixture of oxides was obtained either by precipitation from mixed solutions, or by evaporation and ignition of the nitrates. Heat was applied to the reduction-tube by means of a sand-bath, with a thermo regulator. The experiment is completed when the height of the water closing the open limb of the tube remains constant.

The result of the experiments was as follows :—

1. Copper and zinc. End of the experiment after 5 hours; found 0·034 grm. oxygen of the copper oxide. Calculation required 0·0338 grm.

2. Copper and silver. Duration 45 hours; found 20·9 instead of 20·5 milligrms.

3. Copper and bismuth. 26 hours; 20·2 instead of 20 milligrms.

4. Copper and cadmium. 22 hours; 28·4 instead of 28·5 milligrms.

5. Copper and lead. 45 hours; 19·2 instead of 18·8 milligrms.

6. Copper and tin. 9 hours; 12·3 instead of 12·4 milligrms.

7. Silver and iron cannot be determined, their oxides forming a chemical combination.

8. Silver and lead could not be determined.

9. Arsenic and antimony could not be determined.

10. Mercury and iron. 25 hours; 19·6 instead of 20·5 milligrms.

11. Copper, iron, and zinc. 10 and 26 hours; 17·5 instead of 17·6 and 16·8 instead of 16 milligrms.

12. Copper, cadmium, and zinc. 12 and 2½ hours; 24·2 instead of 25·2, and 11·2 instead of 10·9 milligrms.

13. Copper, tin, lead, and zinc, could not be jointly determined, though it was possible to determine copper, tin, zinc and copper, lead, zinc.

14. Copper, manganese, iron, and zinc. The method was found inapplicable.

It appears that oxides, even when jointly precipitated from a solution, remain uncombined.—*Berichte der Deutsch. Chem. Ges. zu Berlin.*

ESTREMADURA PHOSPHORITE.

By Dr. B. C. NIEDERSTADT,
Sworn Commercial Chemist.

For the last two or three years a mineral substance containing phosphoric acid, and used as manure, has been imported to our market from Spain. It is found in the province of Estremadura, especially in the neighbourhood of Logrosan, and is obtained by mining. It appears in the market in pieces, the size of a fist, knotty, and is hard as stone, of a yellow-reddish colour.

It is found in considerable quantities; and the facility of importation to Hamburg has rendered it an extensive import article, amounting in the year 1872 to 11,000 kilos., and more than 100 cargoes have already been imported. This mineral is greatly to be preferred to Lahn phosphorite (which contains 3 to 6 per cent iron oxide, and 1·5 per cent aluminium oxide), because, in consequence of the trifling quantity of the materials above mentioned, it is not exposed to the risk of the phosphoric acid becoming insoluble, which is generally the case.

The percentage of phosphoric acid, as shown in various investigations, is considerably reduced by a preponderating quantity of quartz; and scarcely amounts to 28 per cent, as proved by various experiments.

When compared with the most valuable sorts of guano —such as Baker, Curacao, and Bolivia—which contain more than 34 per cent phosphoric acid, this contains fully 6 per cent less. While, therefore, the latter furnishes a superphosphate of 14 to 16 per cent dissolved acid, the value of the phosphorite must be correspondingly inferior, according to the analysis.

The superphosphate has a crumbling, dry form. The quantity of carbonate of lime varies greatly, sometimes amounting to even more than 20 per cent, and the analysis therefore requires a greater quantity of acid. The results of the various analyses were :—

	"Porto Packet."		
Phosphate of lime ..	54·691	Phosphoric acid	25·052
Phosphate of magnesia	7·010	" "	3·798
Carbonate of lime ..	8·065		
Sulphate of lime ..	1·200		
Iron oxide	0·621		
Aluminium oxide ..	0·165		
Fluoride of calcium ..	1·520		
Manganese	trace		
Silicic acid	25·720		
Water	0·250		
	99·242	Phosphoric acid	28·350
	"Maria Sophia."		
Phosphate of lime ..	62·352	Phosphoric acid	28·653
Phosphate of magnesia	1·605	" "	1·026
Carbonate of lime ..	13·688		
Sulphate of lime ..	2·440		
Iron oxide	0·528		
Aluminium oxide ..	0·985		
Fluoride of calcium ..	1·204		
Silicic acid	16·412		
Water	0·175		
	99·389	Phosphoric acid	29·679
	"Catharina."		
Phosphate of lime ..	57·369	Phosphoric acid	26·280
Phosphate of magnesia	0·708	" "	0·383
Carbonate of lime ..	7·385		
Sulphate of lime ..	1·599		
Iron oxide	0·453		
Aluminium oxide ..	0·405		
Fluoride of calcium ..	1·822		
Silicic acid	29·428		
Water	0·790		
	99·959		26·663
	"Stamboul."		
Phosphate of lime ..	59·594	Phosphoric acid	27·300
Phosphate of magnesia	3·977	" "	2·155
Carbonate of lime ..	13·327		
Sulphate of lime ..	0·858		
Iron oxide	0·910		
Aluminium oxide ..	0·427		
Fluoride of calcium ..	0·983		
Manganese	trace		
Silicic acid	19·164		
Water	0·721		
	99·961	Phosphoric acid	29·455

Hamburg, March, 1875.

ON THE MANUFACTURE OF CAUSTIC SODA.*

By JOHN MORRISON, F.C.S.

(Continued from page 135.)

The third branch of my subject I am compelled to treat very superficially. I need not enter into the composition of the vat liquors. Those from the causticiser stand from 14° T. to 16° T., and contain about 4¼ per cent alkali, and 0·15 per cent sulphide, together with sulphite, hyposul-

* A Paper read before the Newcastle-upon-Tyne Chemical Society.

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phite, and sulphate of soda; also chloride of sodium, with traces of other compounds.

For several reasons it is important that the lime used in causticising should be of first-rate quality. Some of the inferior or impure varieties of Welsh, Derbyshire, or Lancashire limes, produce a bad settling liquor, so that it rarely pays to employ them, even though procurable at a very cheap rate. The limes of the Buxton Lime Company, and those of Messrs. Kneeshaw, Lupton, and Co., Abergele, are, I think, the best at present brought into Widnes.

The lime mud on the filters almost invariably contains about 50 per cent moisture. The variation in the best samples rarely exceeds 5 per cent, whether the filtration has been effected with a vacuum or without. Consequently, it would appear that the air pump simply augments the rapidity of filtration, but does not really increase the dryness of the mud, even though—as it generally does—the mud which has been filtered by means of a vacuum underneath the bed appears firmer and less pulpy than mud filtered simply by gravitation. When the mud has been cast from the filter "beds," however, it rapidly dries under the influence of the atmosphere.

It seems practically impossible to remove all the soda from this mud; and beyond a certain point, washing has apparently no effect. An average sample of properly treated magma contains about 2¼ per cent alkali, in the dry state, representing 1¼ per cent in the condition in which it leaves the filter beds. And as about 11 cwts. good burnt lime are consumed per ton of 60 per cent caustic soda, producing say 36 cwts. mud, the total amount retained would be 50 lbs. alkali per ton of 60 per cent caustic soda, or about 2¼ per cent. Supposing, however, we have a weak lime to deal with, and consume 20 cwts. per ton of caustic soda produced, this would give us, say 3 tons mud, representing a loss (supposing always the amount of alkali withheld to remain the same) of 84 lbs. Na_2O per ton of caustic soda, or nearly 4 per cent; and this, to say nothing of the extra labour involved in its utilisation in the black-ash furnaces. The above loss, of course, assumes that none of the soda is recoverable in the black-ash furnaces, which for all practical purposes is taken for granted, although my own impression is that 30—50 per cent reappears in the balls.

It was some years ago proposed by Muspratt to expel the water and carbonic acid from the mud by calcination, and so to use the lime over and over again; and though it is just possible that the regenerated material might be less energetic than the freshly burnt lime from the kilns, the experiment seems worthy of a trial. So far as I know, however, the suggestion has never assumed a practical shape. Perhaps by moulding into bricks, and calcining in an ordinary fire brick kiln, it would be possible, in a sufficiently cheap way, to revivify the mud completely. And its utilisation in some such way would, of course, effect an important diminution in the loss of alkali, as well as reducing the consumption of the lime itself.

Next in order come the "fished salts" from the boat pans. These, after draining, contain as follows:—

Moisture	18·00
Na_2CO_3	39·00
NaHO	9·00
Na_2SO_4	29·00
NaCl	0·50

With hyposulphite and sulphite of soda.

In appearance they are like dirty white sand. There are about 2 tons of dry salts to each batch of 10 tons of caustic soda produced, and which continually carry back into process, on the above approximate analysis, nearly 5 cwts. of caustic soda, together with 18 cwts. carbonate, and 13 cwts. sulphate soda. These salts are practically innocent of sulphides if a little nitre has been added to the liquor in the boat pans.

This much, however, cannot be asserted of the pot-settler "fishings." If a sample of them be dissolved in water, a green solution will at first be the result, but if this be allowed to remain exposed for a day or two to the action of the atmosphere, it will become quite colourless, owing to the oxidation of the sulphides present, and the deposition in a granular state of the iron held by them in solution.

The "bottoms" amount to 9 to 11 per cent of the caustic soda produced, and without they fetch a pretty good price in the market, it pays best to re-dissolve and work them up again. They are sometimes sold on a basis of 54 per cent, and so much per degree over that margin; but more generally at a price 54 per cent being guaranteed. When the latter is the case, they may be reduced to the requisite strength with fished salts. They originally vary considerably in strength, and if a pot be salted after it has settled well, they will test higher in alkali than the supernatant caustic, but if it be salted either before or immediately after nitreing, they will show less alkali. They usually contain a little lime, 3—4 per cent peroxide iron, and 5—6 per cent aluminate and silicate soda, besides the carbonate and caustic soda, and chloride and sulphate sodium.

The pots previously to oxidation contain 1¼ to 2 per cent sulphides, or about 35 lbs. per ton, to convert which into sulphate 29 lbs. of oxygen are necessary, this amount being represented by about 56 lbs. nitre. The latter, however, is in excess of the amount regained, showing that during the oxidation process other resources must be drawn upon to complete the reaction. The decomposition may be stated as follows:—

$$Na_2S + NaNO_3 + 2H_2O = Na_2SO_4 + NaHO + NH_3;$$

or at a higher temperature:—

$$5Na_2S + 8NaNO_3 + 4H_2O = 5Na_2SO_4 + 8NaHO + 8N.$$

The amount of nitre actually used is 40 to 45 lbs. to the ton of caustic soda, and in the case of air, 25 to 30,000 cubic feet are generally sufficient with good liquor. Simultaneously with the destruction of the sulphides, the iron held by them in suspension separates as peroxide.

At the temperature at which the oxidation is commenced, no sulphite or hyposulphite will be present, those having previously broken up to form sulphate and sulphide, so that we have probably only sulphides to deal with. Could we by any practicable method precipitate the sulphur as a metallic sulphide, and gain by that means an equivalent of caustic soda, we should of course be able to augment somewhat our present strength of available alkali; but no method so far as I am aware—unless indeed it be in the single works at St. Helens (the Greenbank Alkali Company) in which 76 per cent (Hudson's test) is manufactured—is practised with this view, although the reverse process was in use a few years ago in the small "Bachêt" experimental works at Walker, where it was attempted to manufacture caustic soda from common salt directly, by reacting upon it with litharge, and where M. Bachêt was accustomed to precipitate the lead unavoidably present in his caustic liquors with solution of sulphide sodium. For practical purposes it is estimated that half the weight of nitre used is returned in the usually (but not always) more valuable shape of caustic soda, so that when nitre is cheap, and caustic high, it pays best to adopt it as the oxidising agent in preference to a blast of air; but when nitre is "up," and caustic depressed, blowing is the cheaper. Whether of the two methods to adopt, therefore, is at all times—given the prices of caustic soda and of nitre, and the cost of blowing—easy to calculate. Nitreing reduces the amount of total available alkali from 1 to 2 per cent, blowing a little more. Blowing, as I have previously remarked, requires more pot room than nitreing, and it is also inadmissible in the case of cream caustic, the finishing temperature being too low.

I have spoken of the care necessary on the part of the workmen towards the close of the oxidation process to prevent the batches becoming green. This discolouration

is supposed to be due to manganese derived from the lime, and which appears to exist in presence of sulphides as a lower oxide, but simultaneously with the destruction of the last trace of sulphide to be converted into manganic acid, which immediately laying hold of a portion of soda, forms manganate of soda. At first a very delicate shade of green is produced, but if fresh additions of nitre be made, the colour will speedily become extremely intense or almost black. Prolonged maintenance at a high temperature will also, but much more slowly, bring about a similar reaction.

I need hardly allude to the graphite or the ultramarine, which appear in the final stages of the caustic soda process, possessing as they do but little practical interest. The former is probably formed by the decomposition of the cyanides, and ferro and sulphocyanides, some or all of which are invariably present in vat liquors, and are carried right through the process till their final destruction at the high temperature to which they are subjected when they go to form ammonia (the hydrogen being derived from the water present, the oxygen of which has been abstracted by the sulphides during their oxidation) which passes off, and graphite, &c. The latter is perhaps due to the formation, by the action in the "balling" process of the sulphides, &c., on the silica and alumina of the limestone, of uncertain compounds of silica, alumina, and soda.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 23, 1875.

R. ANGUS SMITH, Ph.D., F.R.S., &c., Vice-President, in the Chair.

MR. JOSEPH SIDEBOTHAM, F.R.A.S., sent for exhibition a specimen of the Colorado potato beetle (*Doryphora decomlineata*), which had appeared in great numbers in Canada last year, and had caused great destruction in the potato crops.

Ordinary Meeting, March 9th, 1875.

EDWARD SCHUNCK, PH.D., F.R.S., &c., President, in the Chair.

MR. ARTHUR MCDOUGALL, B.Sc., invited attention to a specimen of carbon formed upon the roof of a gas retort by the decomposition of the hydrocarbon gas by heat. The carbon thus formed resembles graphite in its almost metallic lustre, and it was suggested that its mode of formation might throw some light upon that of graphite. Graphite always occurs in association with rocks which have been subjected to igneous action, and may have been formed by hydrocarbon gases traversing fissures or dykes whilst the sides were in a highly heated state, thus causing a deposit similar to that formed in gas retorts. The fact that in the latter case an increase of pressure causes a greatly increased amount of deposit favours this view, as it is extremely probable that any gases existing in the earth's crust would be in a state of great tension.

"*On the Presence of Sulphate of Copper in Water Heated in Tinned Copper Boilers*," by WILLIAM THOMSON, F.C.S.

A few weeks ago I was consulted with regard to some water which was taken from a copper boiler in a kitchen range, which led me to investigate the case, and, as the results seem to be of vital importance to many, I venture to bring them before your notice.

The range referred to belonged to a large chapel in Manchester, and was employed for culinary purposes in connection with various meetings of the congregation, &c. It was originally formed of two iron boilers, each capable of holding from 30 to 40 gallons, with a fireplace between. One of these boilers was cracked, through cold water having been carelessly thrown on the iron after it had been allowed to become nearly red-hot. To repair this defect, a copper boiler, coated with tin, was fitted into the cracked iron one. I was informed that this boiler, together with the iron one on the other side of the range, had been employed for heating water for tea-making at one or more meetings, and that some persons complained of feeling ill after tea. Some of the hot water from this boiler was afterwards employed for washing, and as it broke up the soap like hard water, and threw to the top a scum which had a bluish colour, suspicion was thrown on it, and a sample of the water brought to me for examination. It contained some matter in suspension of a dark colour, which soon subsided, and left the water clear. Presuming that if copper were present it would be in suspension and not in solution, I examined the sediment, but found it to be free from that metal. I then filtered and examined the clear water.

It contained a large proportion of copper in solution, and gave a distinctly acid reaction to blue litmus-paper. I evaporated the water down to a very small bulk, and extracted the free acid with absolute alcohol, eliminated the alcohol used, and got it in a concentrated form in a water solution: it charred paper with facility, and gave a copious white precipitate with chloride of barium insoluble in hydrochloric acid, thus proving it to be free sulphuric acid which had acted upon the copper. I then continued my investigation to find the source of that acid. I observed that the boilers on each side of the fireplace were supplied by the same water (Manchester supply), passing along the same pipe. I collected a sample of that water from the tap used for filling the copper boiler, and took another from the iron boiler on the other side: these samples were evaporated down and tested, but found to contain neither free acid nor copper. I next looked for the acid as a result of the combustion of sulphur in the coal, but as both boilers were entirely separated from the fire by brickwork, and also covered in on the top, the products of combustion had no chance of finding their way into the boilers; and, further, had this been the cause I ought to have found free acid in the water of the iron boiler.

On further enquiry, I was informed that after the boiler had been put in it was well washed with water, and afterwards had a solution of washing-soda boiled in it, and again washed well with clean water. After this treatment, water which was heated in it became highly contaminated with copper and free sulphuric acid.

My experiments up to this time having offered no solution of the problem as to how the water became contaminated, I made enquiries respecting the galvanising of such utensils, and found that the process followed was this:—The inside of the vessel was "pickled" with sulphuric acid, then rubbed with sand to remove oxide, and washed; lastly, heated up with chloride of ammonium, and block-tin rubbed over the surface.

The only explanation which I can offer of this remarkable contamination is, that part of the sulphuric acid used for cleansing before galvanising had been secreted in the joints formed by the riveting of the sheets of the copper together, and also between the plates and the rivets, so that when the boiler was washed and heated with a solution of carbonate of soda, it could not enter into the crevices to neutralise the acid during the few hours the soda solution was heated, but which, under the subsequent prolonged action of the hot water, gradually dyalised out, bringing the copper with it.

I called one day at the chapel, and found them using the hot water from this boiler for washing dishes, so that fresh quantities of pure water were being added as the hot water was drawn off. I took another sample of it, and on analysis I found it to contain 3·575 grains of metallic copper to the gallon, equal to 14·056 grains of crystallised sulphate of copper. I consider it well that results such as

these should be generally known, as I understand that boilers of this kind are often employed for culinary purposes, and through ignorance of the above facts serious results might accrue.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

Monday, February 15th, 1875.

Mr. James Mactear, Vice-President, in the Chair.

Mr. J. J. Coleman, F.C.S., read a paper "*On the Methods in Use for Testing Hydrocarbon Illuminating Oils.*" The author in the first instance compared, with some detail, the composition of Pennsylvanian crude petroleum with that of crude paraffin oil, in respect of the various products of distillation and the specific gravities of those which are liquid. His remarks were made chiefly in reference to the groups of hydrocarbons which, both in America and in this country, are isolated from the rest of the crude oil, and designated burning oils; and he said that the paraffin refiners had steadfastly adhered to the principle of separating all volatile hydrocarbons so carefully from burning oils intended for general use, that it would be difficult to find any sample of paraffin burning oil in the market that would give off inflammable vapour under 120° F., whilst the bulk of American petroleum-burning oils were so far contaminated with naphthas that it was very difficult to get a sample of imported petroleum which would not give off inflammable vapours at from 90° to 100° F., tested in the same manner as would result in a flash point of 120° for the paraffin oils. The habit adopted by the Scotch refiners in sending out *safe* oil was due to a regard to the public safety. When crude oil of either kind was deprived of its tarry, basic, and acid impurities by successive treatment with acid and alkali, the purified hydrocarbons were fractionated into groups, such as naphtha, burning oil, lubricating oil, &c., by the process of fractional distillation. By repeated distillations American petroleum is often broken or "cracked" up into—

Crude naphtha	..	20 parts
Burning oil	.. ..	66 ,,
Coke and loss	.. ..	14 ,,
		100

This fact was shown by the author to have an important bearing in connection with the statistics of exportation of refined petroleum from America. While the amount shipped from America was on the average 356,908 tons per annum during the years 1866 to 1870, inclusive, it has latterly risen to an average of 705,200 tons per annum, Great Britain only taking about five per cent of the whole. Taking Dr. Chandler's average composition of crude petroleum, the refined products per annum during the last four years would be—

Naphtha	179,640 tons.
Heavy oil, containing a little paraffin	243,775 ,,
Gasoline	19,247 ,,

Considering that the whole animal and vegetable oil vended in Great Britain does not amount to 200,000 tons per annum, it would be difficult to conceive how the Americans disposed of 243,775 tons of heavy oil for lubricating purposes. In practice, however, they don't produce such a quantity of that material; they take advantage of the principle already referred to, that of "cracking" it up into burning oils of lighter specific gravity. It would be difficult, likewise, to conceive how they got rid of 179,640 tons of naphtha as naphtha. They do not export it in large quantities. During last year they only exported about 30,000 tons of naphtha, Great Britain getting one-half. But they got rid of it in the following manner:—1. By using the lighter portions for air gas; 2. By burning vast quantities of crude naphtha for heating purposes; 3. By putting as much as they dare into the burning oil: and they are only stopped from going to an unlimited extent by the legislative acts of the foreign countries to which the material is exported. The specific gravity would not be materially affected, seeing that the light naphtha was added to an oil of heavy gravity; but at first sight the adulteration would not be detected. This irregularity, however, could be detected by fractional distillation, a system which was adopted by Mr. Valentin in 1871 with much success. After referring at some length to Valentin's experiments, the author proceeded to say that the Americans themselves had become thoroughly alarmed at the indiscriminate sale of dangerous burning oils in their own country, and that most exhaustive chemical reports had been made on the subject from time to time to the Board of Health Department of New York and to the Franklin Institute, no fewer than 639 samples being tested for the former body in 1869, of which only 21 did not give inflammable vapour at 100° F. In 1871, out of 100 samples tested only 7 were safe oils. These statistics, coupled with others in respect of the deaths from dangerous oils in the United States, and the fires in New York from the same cause, there had been legislation in many states of the Union,—the local Acts fixing various tests, such as from 120° F. down to 100° as a fire test; 100° F. as a vapour test; and 110° to 100° as a flash test. Mr. Coleman next described the Petroleum Act of 1871, and the subsequent attempts at legislation in this country on the same subject. He mentioned the chief provisions of the Act, and said that the weak point of the Act was the system of testing fixed by the Schedule; indeed, it was so indefinite that chemists obtained results differing from one another to the extent of even 10° or 15°. In concluding his paper, the author drew attention to the fact that a burning oil was most economical photometrically when deprived of its volatile matters, or naphtha, and therefore legislation on the subject could not have any effect in deteriorating the value of the American products. He said that, as chemists, the members of the Section would understand that the relative illuminating power of hydrocarbon illuminants was dependent upon their relative richness in carbon, which increased in proportion to the specific gravity of the oil. The question of burning illuminating hydrocarbons was a question of lamps, which should be so constructed as that there must be a sufficient amount of oxygen supplied to the flame. That condition had been perfectly attained; and paraffin oils, from their greater density and their less volatility than the average of American petroleums, had been proved to be photometrically more efficient in the proportion of about 13 per cent.

In illustration of remarks made in the course of his paper, the author enlarged upon the systems of testing, but he would not commit himself to any recommendation as to what the flash point should be in future. He also performed a number of experiments with different forms of lamps and wicks.

A long and interesting discussion followed the reading of the paper. A visitor said that there was a much greater quantity of the lighter hydrocarbons in crude petroleum than in crude paraffin oil, and hence there was much more trouble to get rid of them. The quantity was from 15 to 20 per cent as against 5 per cent. In answer to a question put by a member, he said that they were more difficult to separate in the first instance than if they had been separated and then added to heavy oils.

Mr. R. R. Tatlock was surprised that some more exact method of testing mineral oils had not been devised, such, for instance, as the amount by weight a volume of the oil consumed at different temperatures and in a certain length of time. The difference of the rate of heating the oil had certainly some effect in determining the flashing or firing point, for the slower it was heated the longer it would be before it rose in temperature to, say, 100° F., and most of the volatile hydrocarbons would by that time have escaped. The speaker also referred to the

admixture of oxidisable oils with mineral oils, and considered the subject in its relation to spontaneous combustion and the question of fire insurance.

After some remarks by Mr. Nathaniel Dunlop and the Chairman,—

Mr. COLEMAN said that the method of testing suggested by Mr. Tatlock would certainly be the most scientific, but brokers and commercial people would scarcely accept of it. In answer to the Chairman, he said that circular wicks were preferable to flat wicks.

SOCIETY OF PUBLIC ANALYSTS.

ADULTERATION ACT, 1872.

JUST now, when the working of this Act is being so generally discussed, the following Table—showing to what extent and with what results it has been put into operation in different districts—may not be without interest. It is necessary to add that the list of places is not a complete one, as there are some where Analysts have been appointed from which we have no return; but it is sufficiently full to convey a fair idea of aggregate results.

Place.	Time that the Act has been in Operation.	Total number of Samples Analysed.	Number found to be Adulterated.	Number of Convictions.	The Adulterated Samples included—					
					Milk.	Tea.	Mustard.	Butter.	Bread.	Coffee.
	Mos.									
Hackney ..	21	198	28	13	7	1	3	2	—	—
Buckingham and Bucks	—	22	3	—	2	—	—	1	—	—
Bedfordshire ..	21	570	42	20	5	4	12	5	7	5
Bristol	13	253	90	5	30	11	9	11	—	11
Wigan	16	58	11	2	6	—	—	—	—	3
Limehouse ..	19	169	15	5	3	—	4	—	4	—
West Sussex ..	20	48	2	—	—	—	—	—	—	—
Huddersfield ..	15	18	1	—	1	—	—	—	—	—
Kensington ..	8	140	25	20	16	—	2	1	—	1
Southampton ..	9	21	7	—	7	—	—	—	—	—
Worcestershire	27	246	68	—	45	5	15	2	—	—
Newcastle-on-Tyne ..	27	275	93	14	74	3	—	—	—	1
Devonshire ..	12	58	28	—	—	6	10	—	—	8
Westminster ..	20	242	41	16	28	—	2	—	—	5
Londonderry ..	25	158	43	5	30	2	2	—	—	1
Bradford	9	114	24	24	10	—	2	—	—	—
Durham	14	58	10	1	8	2	—	—	—	—
Gateshead ..	15	92	38	20	30	8	—	—	—	—
St. Saviour's, Southwark	10	128	36	23	22	—	—	—	—	—
Camberwell ..	25	545	68	66	59	—	1	1	5	—
Rotherhithe ..	9	45	6	—	5	—	—	—	—	—
Bermondsey ..	17	281	45	33	25	—	8	—	—	10
Lambeth	20	252	29	28	10	—	5	—	3	9
St. George's, Southwark	20	92	22	21	10	—	3	1	—	5
Wandsworth ..	20	974	84	22	24	—	7	—	—	29
Isle of Man ..	23	140	33	25	—	—	—	—	—	—
Cheshire	26	587	164	96	—	—	—	—	—	—
Liverpool.. ..	30	368	117	60	—	—	—	—	—	—
Lincolnshire ..	30	1036	490	66	—	197	129	—	62	43
Somerset	12	2216	845	520	—	212	294	26	—	106
Manchester ..	15	75	12	7	—	—	—	—	4	—
Greenwich, Plumstead, & Woolwich	16	701	84	—	48	12	4	—	11	6
N. Staffordshire	14	830	341	135	40	83	14	—	—	—
Landport	18	191	—	15	9	—	3	—	—	3
St. Pancras ..	25	570	79	23	56	5	—	—	7	6
Shoreditch ..	22	87	22	8	12	2	—	7	—	—
Surrey	23	1513	168	140	34	22	70	6	3	24
Ipswich	18	None	None	None	—	—	—	—	—	—
Colchester ..	12	1	1	None	—	—	—	1	—	—
Cornwall	18	None	None	None	—	—	—	—	—	—
Cambridge ..	12	2	1	—	1	—	—	—	—	—
Swansea	2	56	28	16	23	—	—	—	5	—
Montgomerysh.	12	17	6	—	3	—	3	—	—	—
Shrewsbury ..	12	7	3	—	3	—	—	—	—	—
Shropshire ..	30	26	5	2	2	1	—	—	—	—
East Suffolk ..	10	2	—	—	—	—	—	—	—	—
Brighton	12	114	14	6	8	—	—	6	—	—
S. Staffordshire	22	526	251	—	88	137	21	1	—	1
Wolverhampton	22	163	56	—	20	14	9	4	—	1
Birmingham ..	30	165	102	38	38	41	6	2	—	—
Leeds	19	270	32	18	15	3	—	—	1	—
Monmouth ..	24	9	2	—	2	—	—	—	—	—

Place.	Time that the Act has been in Operation.	Total number of Samples Analysed.	Number found to be Adulterated.	Number of Convictions.	The Adulterated Samples included—					
					Milk.	Tea.	Mustard.	Butter.	Bread.	Coffee.
	Mos.									
Cork	32	171	32	—	—	—	—	—	8	5
Reading	12	28	1	—	—	—	—	—	—	—
St. George's, Hanover-sq.	16	154	51	—	—	—	—	2	—	33
Edinburgh and Leith ..	20	126	35	11	—	—	—	—	—	—
Gravesend ..	12	10	10	1	—	—	—	—	—	—
Lewisham ..	21	123	18	17	14	1	1	—	—	—
Hampstead ..	12	39	1	—	—	1	—	—	—	—

NOTICES OF BOOKS.

Water Analysis as it Should and as it Should not be Performed by the Medical Officer of Health. By C. B. Fox, M.D., Author of "Ozone and Antozone." London: J. and A. Churchill.

THIS little book, with a title as lengthy as the name of some newly-discovered chemical compound, is an extension of a paper read by the author before the Norwich Meeting of the British Medical Association in August last. The author tells us that it "was not written for the instruction of *dummy* Medical Officers of Health, who receive £5 or £10 a year as a salary, with the understanding that they are to do nothing." We fear that the existence of such sham Health-Officers, appointed not to execute but to evade the sanitary laws, is an undeniable fact. The tacit "understanding" of which Dr. Fox speaks might, indeed, be difficult to prove. But when a gentleman accepts for such a sum duties which, if really performed, would engross perhaps half his time, it is but fair to infer that his functions are no less nominal than his salary. We could name a little town where, behind every dwelling, the cesspool and the draw-well stand in amicable propinquity, separated by at most six yards of gravel, shingle, and chalk. The "conscript fathers" of that town have appointed a Health-Officer at £10 a year, and we are certain that any display of conscientiousness or vigour on his part would lead to his dismissal at the earliest opportunity.

Dr. Fox has a threefold object in the book before us. He wishes "to induce all *real* Medical Officers of Health to adopt some one reliable method of water analysis, so that the results of the examinations of all might be comparable, to demonstrate to them the superiority of the Nessler process to any other," and to give them some of the results of his own experience. To all this no objection can be taken. Uniformity of method is absolutely necessary where a number of observers are working independently towards one common end. The ammonia (or Nessler) process may not be absolute perfection, but until some method which can be placed in competition with it, without utter absurdity, it is fully entitled to that preference which it receives from practical sanitarians throughout the civilised world.

As regards the permanganate of potash test, Dr. Fox furnishes some interesting facts showing its utter untrustworthiness. Enteric fever broke out at Ingatestone, and was confined to the market-place, The water of the public well, tested with permanganate of potash, gave no indications of impurity. The fever still spreading, the water was analysed by Wanklyn and Chapman's process, and condemned. The well was closed, and the inhabitants directed to a pure source of water, and the fever speedily disappeared. It was afterwards found that a "rotten drain" passed within two yards of the well. Another case, given by Dr. Parsons, is quoted from *Public Health*. Five persons, using a certain well, were simultaneously attacked with enteric fever. The owner of the well

refused to believe that the water could be at fault, because it was clear, scentless, tasteless, and did not decolourise Condy's fluid. Yet, on analysis, it showed 1·08 grs. of albumenoid ammonia per million grains, and "on examination it was found that the cesspool of a privy had overflowed into it." Two waters from neighbouring pumps were brought to the Health Officer in one of the south-western counties. On the faith of the permanganate test, he pronounced one pure and the other quite impure and unfit for use. To his no small discredit it was found that both pumps were supplied from the same well. For many more valuable chemico-sanitary facts,—wonderful in amount if we consider the small number of pages,—we must refer to the book itself.

We have great pleasure in recommending this excellent manual not merely to the body for whom it was primarily intended, but to members of town councils, local boards, &c. It may awaken them to truths which they are fearfully apt to overlook.

Of all places in the world, the reader would be least likely to look for an attack upon "Darwinian" views in a pamphlet on water analysis. Yet here it is, in the shape of a condemnation of Professor Tyndall's view, that "the typhoid poison cannot be spontaneously generated." This,—admitting the said poison to be an organism,—is a view more befitting an advocate of "special creation" than an evolutionist. Dr. Fox has proved himself capable of original research. He should, therefore, be above bringing charges of "materialism" against opponents. Let him leave such unknightly weapons to Belfast squads and canons of St. Denis.

Announcement of the Stevens Institute of Technology; A School of Mechanical Engineering, founded by Edwin A. Stevens, Esq. Hoboken, New Jersey. 1874.

On the European continent, statesmen, well knowing how largely the prosperity and the power of a country turns upon its eminence in physical science, found and maintain universities, laboratories, libraries, and every appliance needful for the cultivation and diffusion of technological knowledge. In America, the princely liberality of private citizens more than atones for the inaction of the Government. By the will of the late Mr. Stevens, a sum of money not less than 650,000 dols. and a valuable plot of land in the city of Hoboken were left to trustees for the foundation and establishment of a school of mechanical engineering. Now with mechanical engineering we have certainly little to do. But the institution in question is most elaborately fitted up for the study of chemistry and of the higher branches of physics. Turning to the department of optics, we find that the new institution possesses the instruments of the late C. N. Bancker, of Philadelphia, "long known to men of science as the most extensive museum of optical instruments existing in any part of the world." There are two "spectroscopes by Browning, and one by Desaga, reflecting and refracting-telescopes of every system, an excellent Zentmayer microscope, and thirty-four complete instruments for the study and application of polarised light alone." The collections of magnetic, electric, and chemical appliances are on a corresponding scale of completeness.

The annual fee for each student will not exceed £20, which, if somewhat higher than the German scale, is not more than one-third the sum charged for a similar course of tuition in England.

Such things are being done in America, whilst we cleave to the "three R's" for the many, and to "longs and shorts" for the few. Can there be a shadow of doubt as to the final result?

Influence of Pressure upon Combustion.—M. L. Cailletet.—The dissociation of the gaseous carbides, and the aspect of the spectra, demonstrate that the temperature of combustion is increased by pressure, though this increase is not necessarily very great.

CORRESPONDENCE.

MANUFACTURE OF CAUSTIC SODA.

To the Editor of the Chemical News.

Sir,—In conjunction with many other workers upon this subject, I have looked anxiously forward for the completion of the papers by Mr. John Morrison to see what and all he really has to say upon the subject, and several of us not accrediting many of the statements in which Mr. Morrison's paper abounds (as managers and chemists of works making caustic soda) have met privately to discuss one or two of the points, and to try and discover where some of the extraordinary work, detailed in the paper alluded to, was carried on.

When the paper was read before the Newcastle-on-Tyne Chemical Society, we have all here wondered what sort of opinion the audience had of Lancashire workmen. To talk about 34 balls being a good double shift's work, is causing a deal of amusement here, especially when 14 to 16 balls, each containing 3 cwts. of salt-cake, 4 cwts. of lime mud, a quantity of limestone—to which the works' physician would probably append Q. S.,—and 1¼ cwts. of slack, is spoken of as the usual 12 hours produce.

It is always accorded to travellers that they have seen wonderful things, and we "Lancashire lads" are perhaps behind in that respect, with this exception—that we keep our eyes open to the real, trying to grasp the trade as a whole, and not individually, as we find those north and those south of us do. A Lancashire manager should know all the details of processes carried on at the Tyne, for in Lancashire is made ash both carbonated and caustic together with white and cream caustic soda.

Caustic ash and white caustic soda is the exception on the Tyne. The first we know is so, and Mr. Morrison tells us that the manufacture of the latter is almost entirely confined to the Lancashire districts.

In spite of this remark, which is a truism, we have managers come down here from the Tyne to teach our "young idea" how to make white caustic.

Mr. Morrison is genuine indeed, for, after dilating upon the superiority of practical experience over chemical reasoning and ability, he says—"This practical experience" (either our own or some one else's)—and we Lancashire lads are greatly of opinion, reasoning from the statement that the manufacture is confined chiefly to Lancashire, that it is "some one else's" experience which has been the germ or nucleus of all that has followed. We should not care about this migration from the north if the rash statements would be suppressed, such as we complain of in the present letter. Another case:—A manager has resigned his post. A Tyne man made an application for his post; he was taken round the works by the proprietor, and saw a caustic ash being drawn, containing 11 or 12 per cent of caustic alkali. He said, "Why do you allow the men to draw it so? We draw it 'like a ball of fire.'" It would be very interesting to see it drawn in that condition, but some one else's experience had been drawn from, and the manager returned, to say the least, a wiser man.

These statements do a deal of harm. Proprietors would perhaps say, "They draw 17 balls in Lancashire per 12 hours shift,—we must do the same;" when in fact they do not. Nearly 40 per cent of the alkali manufactured in Lancashire is made in St. Helens, and what is their usual thing? Twelve balls per day shift, and sometimes 13 in the night shift; and these balls mostly contain only 2¼ cwts. of salt-cake, or are one-sixth less in size than those mentioned by Mr. Morrison. These places, producing smaller balls, less number, and, consequently, a smaller turn-out, are paying most of them even now. Can Mr. Morrison say this of all the Widnes small works?

This letter would not have been written, had not Mr. Morrison dilated rather too freely against "philosophic

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methods of reasoning peculiar to the chemist," and tried to elevate into its place that power "peculiar" to the brute creation—"instinct or intuition." Is there not as much philosophic reasoning in the true working of the theory and laws of heat? Is there not as much science about hydraulics and steam? Is there no philosophic reasoning relating to mechanism, or in the principles of mechanics? To sum up—what in this world works alone, and has one groove to run in without interference from anything else?

In a chemical manufacture, where chemical conditions and physical conditions run side by side, in, out, through, and commingling with, one another, what is the use of chemistry alone? It stands unsupported; but when propped up with the sciences, collateral and cognate, is like the house built upon the rock,—the winds of strikes and the storms of bad prices beat upon it, but it falls not, for it is founded on a rock.

Before concluding, another "Lancashire lad" wishes me to ask how Mr. Morrison came to know that "good white caustic soda from red liquors alone, is—almost an impossibility," seeing that a firm have made "good white caustic soda" from red liquors alone for some years past; but I am afraid that this manufacture will not improve while we have superintendents of processes describing chemical compounds as "salts," "sublime," "scummy sort of crust," instead of describing what they really are.—I am, &c.,

A Lancashire Lad.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 7, February 22, 1875.

New Observations on the Nature of Alcoholic Fermentation.—M. L. Pasteur.—Reserved for insertion in full.

Ruthenium, and its Oxygenated Compounds.—MM. Sainte-Claire Deville and H. Debray.—Pure ruthenium is as sparingly fusible as iridium; and if heated in an oxidising atmosphere it burns with brilliant sparks, a smoky flame, and a decided odour of ozone. The authors submitted ruthenium to the action of oxygen in a porcelain tube, heated to a temperature a little higher than the melting-point of copper. Fremy's crystals were thus reproduced in very fine specimens, into which the whole mass of oxide was transformed, only a very small portion having been transported by sublimation outside the "boat" which it had filled. This observation connects the phenomena with the "apparent volatilisations" of which Troost, Hautefeuille, Ditte, and the authors have given numerous examples. These facts have been explained by the momentary production of an unstable compound, which is dissociated almost at the time of its formation. Hyper-ruthenic acid (RuO_4), the analogue of osmic acid discovered by Claus, is yellow, crystalline, but so unstable that its form has not been determined. It melts at 40° C., and at 108° it is destroyed with explosion. When decomposed it yields strongly ozonised oxygen. Osmic acid, on the contrary, produced by the direct action of oxygen upon metallic osmium, may be maintained in the state of vapour without decomposition. Ruthenic oxide is not reduced by heat like the oxide of iridium. It is found along with iridium, iron, and even platinum in most precipitates and solutions which contain at the same time the two former metals. Iridium, especially, retains ruthenium with great tenacity. Mr. Matthey informs the authors that four or five repetitions of Claus's process do not always suffice to free iridium from the last traces of ruthenium.

Simultaneous Formation, in the Hot Springs of Bourbonne-les-Bains, of various Crystalline Mineral Species, especially of Antimonial Grey Copper (Tetrahedrite), Copper Pyrites (Chalcopyrite), Phillipsite, and Chalcosine.—M. Daubrée.

Action of Borax in Fermentation and Putrefaction. M. J. B. Schnetzler.—The author finds that borax in small quantity arrests fermentation and putrefaction, and prevents the development of low forms of organic life.

Ebullition of Sulphuric Acid.—A. Bobierre.—Noticed elsewhere.

Comparative Study of Gums and Mucilages.—M. Giraud.—The author's investigations have been principally directed to gum tragacanth. Mucilaginous bodies which swell up in water may be divided into three distinct groups. In the first of these is placed gum tragacanth, characterised by the presence of a body capable of giving rise to pectic compounds. To the second belong the mucilages not containing pectic principles, and characterised by the fact that even the weakest acids render them insoluble in water, such as the mucilage of quinces. The third class is free from pectic principles, and is not precipitated by dilute acids, but transformed rapidly, on the application of heat, into a matter comparable with dextrin, and into a saccharoid body. These different bodies present the following properties in common:—Under the influence of dilute acids they are transformed by heat into a sugar different from ordinary glucose, which crystallises readily, does not ferment, and has a greater reducing power than glucose. It belongs to the galactoses of Berthelot. The gummy principles comprised in the last two groups differ from gum arabic in all their characters. Gum tragacanth is sparingly soluble in cold water, and is far from giving, as is asserted, 30 to 50 per cent of soluble gum. The filtrate is a mixture of different bodies, and not a definite principle like arabine. If gum tragacanth is digested in the water-bath with 50 parts of water, after twenty-four hours all the gummy matter is transformed into soluble gum, having lost the property of swelling up after drying. This new matter is not arabine, but pectine. Submitted to the action of acidulated water (1 per cent), it is modified in the water-bath in about three hours, becoming totally soluble. The new body produced is pectine, precipitable by alcohol. The amount of glucose formed during this reaction scarcely corresponds to a tenth part of the material employed. Hence it appears that gum tragacanth contains more than half its weight of a pectic principle insoluble in water, and probably identical with Fremy's pectose.

Examination of the Whey of Luchon.—M. F. Garrigon.

Determination of Boracic Acid.—M. A. Ditte.—If it be required to determine boracic acid contained in a solution in which it is contained alone, or in combination with alkaline oxides, a little ammonia is added to the liquid in order to neutralise any free acid, and then an excess of a saturated solution of pure chloride of calcium. All the boracic acid is then found as borate of lime, as a gelatinous precipitate, soluble in heat in chloride of calcium in excess. The matter introduced into a platinum capsule may be then evaporated to dryness without the least trace of boracic acid being volatilised. When dry, the crucible is filled with a mixture in equal equivalents of pure, crystalline chlorides of sodium and potassium, and heated moderately at first, and then to fusion. The borate of lime, much less fusible, collects at the bottom of the crucible in a spongy matter more or less agglomerated, and dissolves partially in the melting saline mass. If at the bottom of the crucible a temperature is maintained higher than in the upper part, the dissolved borate of lime crystallises on the surface of the liquid, and forms a ring, which rises along the side of the crucible, just above the surface. Soon all the borax is conveyed into this ring, and nothing remains at the bottom of the crucible. The composition of the crystals is BO_3,CaO. They are insoluble

both in hot and cold water. A cold concentrated solution of alkaline chlorides does not affect them; if hot, it dissolves a very small quantity. The matter, when cold, is separated from the crucible, and treated with cold water, when the chlorides dissolve. The crystals are washed on the filter, dried, detached from the filter, and weighed. Care must be taken not to fuse the amorphous borate of lime which occupies the bottom of the crucible in an early stage of the operation. The temperature of the bottom of the crucible should be kept as high as possible short of such fusion. The crucible cannot be heated with a Bunsen burner, but with a gas blast-lamp. On approaching the point at which the borate of lime is fused, the volatilisation of the alkaline chlorides becomes visible. There should be 1 part of pure dried chloride of calcium for 3 parts of the mixture of alkaline chlorides.

Microzymas and Bacteria, in reference to a Remark of M. Balard.—M. A. Bechamp.—A reply to the paper in *Comptes Rendus*, lxxix., p. 1272, November 30, 1874.

Butyric Fermentation Produced by Aquatic Vegetation Immersed in Solution of Sugar.—M. Schützenberger.

Phenomena of Diffraction Produced by Circular Net-Work.—J. L. Soret.—Not adapted for abstraction.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin No. 17, 1874.

Isomeric Dibrombenzols.—V. Meyer.—The author establishes the difference between the nitro-dibrombenzol of Meyer and Stüber, and that of Riese.

Constitution of Certain Substituted Benzols.—C. Wurster and E. Nölting.—The authors describe the preparation of tetra-brom-benzol from tri-brom-aniline, and discuss its supposed constitution.

New Property of Glycerin.—R. Godeffroy.—Already noticed.

Correction.—Eugen Demole.—In the author's method for preparing glycol (*Berichte*, No. 8, p. 641, 1874) the alcohol should be used, not at 80, but at 91 per cent.

Formation of Paralactic Acid by Fermentation.—R. Maly.—In the author's experiments on the formation of lactic acid by the action of the mucous membrane of the stomach upon various sugars in dilute solution, a small quantity of paralactic acid was simultaneously formed in many, though not all, cases. Its presence was proved by the analysis of the zinc salt.

Contributions to the History of Cyan-Acetic and Malonic Acids.—J. van't Hoff.—This paper relates to the action of bromine upon cyan-acetic acid, to ethyl-malonate of potash, and chloro-malonic ethyl-ether.

Dissociation of Sulphate of Copper.—Alex. Naumann.—If a crystal of blue vitriol is exposed, in the vacuum of Hofmann's apparatus for determining the density of vapours, to the temperature of the vapour of boiling alcohol, if the crystal is sufficiently large in comparison with the size of the vacuum, a few spots become white, especially those which receive which the heat first by contact with the mercury or the side of the glass tube. As the increase of the tension becomes gradually slower and slower, the white spots extend, and arise on parts of the crystalline surface previously unattacked. But even after an hour's observation the tension still increases, whilst the white of the parts first attacked becomes a dirty or greenish white, and the crystal is affected to a greater depth. If the crystal is small the whole surface is at once attacked, but becomes gradually darker again as the tension of the vapour rises.

Preliminary Communication.—W. Spring.—If oxychloride of phosphorus is cautiously added to well cooled chlorite of potash a yellowish green gas escapes, which is readily absorbed by water or potash-lye, but no chlorous acid or chlorite of potash is regenerated, but hypochlorous acid or hypochlorite of potash. The gas was proved not to be chlorine.

Derivatives of Guanidin.—M. Nencki.—The author describes formoguanin, its nitrate, hydrochlorate, and double platinum salt; choracetate of guanidin and guanolin.

Colouring Matters of Urine of the Indigo Group, and on Pancreatic Digestion.—M. Nencki.—Reserved for insertion in full.

Action of Alcoholic Potash-Lye upon Dichlor-Nitro-Benzol.—A. Laubenheimer.—The result of the reaction is chiefly tetra-chlor-oxazo-benzol,—

$$(C_6H_3Cl_2)_2N_2O.$$

1,3 Dichlor-Benzol and its Derivatives.—Otto N. Witt.—The author examines 1,2,4 dichlor-aniline, dichlor-aniline-chlor-hydrate; 1,3 dichlor-benzol, dichlor-nitranilin, dichlor-nitro-benzol, and dichlor-phenylen-diamin.

Dinaphthyl-Methan and some of its Derivatives.—Julijan Grabowski.—An account of dinaphthyl-methan; its behaviour with picric acid; tetra-nitro-dinaphthyl-methan; and dibrom-dinaphthyl-methan.

Reduction Products of the Nitro-Benzoic Acids.—P. Griess.—The author gives the name meta-oxy-benzoic acid to the compound $C_{14}H_{10}N_2O_5$, which he formerly designated as azo-oxy-benzoic acid. He examines its behaviour with tin and hydrochloric acid, and describes orthazo-benzoic acid, $C_{14}H_{10}N_2O_5$.

Constitution of the Pseudo-Nitroles.—V. Meyer and J. Locher.—An account of the action of nascent hydrogen upon propyl-pseudo-nitrol; of chromic acid upon the same body; and of dinitro-propan.

Allylic Alcohol in Crude Wood-Spirit.—B. Aronheim.—The author announces that he does not intend to continue the investigation of this subject.

Notice on Diazo-Amido Compounds.—P. Griess.—The two compounds diazo-benzol-amido-brom-benzol and diazo-brom-benzol-amido-benzol are identical.

On Nitro-Ethan.—A. Geuther.

Boiling-Point of Glycerin.—A. Oppenheim and M. Salzmann.—The authors find the corrected boiling-point of glycerin to be 290·4°.

Reduction of certain Aromatic Ketons by Hydriodic Acid and Phosphorus.—C. Graebe.—Not suitable for abstraction.

Difference between the Boiling-Points of Diphenyl and Diphenylen Compounds.—C. Graebe.—The differences, as shown in a table, are about 40° or 41°.

On Cyanamid.—E. Mulder.—The author examines the behaviour of cyanamid with oxalic ether, and the action of the former upon alloxantin, the result of which is iso-uric acid. This body is more readily oxidised than uric acid. Urea does not react upon alloxantin, neither does dicyandiamid. Melamin reacts, but without forming iso-uric acid. Hydurilic acid does not decompose alloxantin.

Cyanamid: Methods for Desulphurisation.—E. Mulder and J. A. Roorda Smit.—Not suitable for abstraction.

Nitroso-Benzol and Nitroso-Naphthalin.—A. Bayer.—The author has not yet succeeded in isolating the former body, nor in obtaining the latter in a state of perfect purity. To prepare the former, he introduces a solution of NOBr in benzol into a solution of hydrargyro-phenyl in benzol in equivalent proportions. The liquid turns green, depositing colourless crystals—probably hydrargyro-bromide of phenyl—and gives off an odour of oil of mustard. The filtered liquid, on distillation in steam, yields a fine green liquid of penetrating odour. The green matter, however, could not be isolated. With tin and hydrochloric acid there was a formation of aniline. On gently heating for a short time with acetate of aniline a deep orange colour appeared, and proportionately large quantities of azo-benzol were obtained. Dilute alkalies destroy the green colour, but not the odour. Concentrated hydrochloric acid decomposes the substance with an orange,

and concentrated sulphuric acid with an intense violet-red colouration. From the formation of aniline and azobenzol it is highly probable that the green body contains nitroso-benzol. The benzol employed as solvent plays no part in the reaction, since it may be replaced by chloroform or bisulphide of carbon without affecting the result. To produce nitroso-naphthalin hydrargyro-naphthyl was dissolved, with the aid of heat, in 50 parts bisulphide of carbon, and when cold treated with a mixture of bromine and bisulphide of carbon, previously saturated with NO at −20°. Nitroso-naphthalin combines with aniline at once, forming a red substance; in concentrated sulphuric acid it dissolves with a cherry colour; if heated with alkalies and acids it is decomposed; and if dissolved in phenol it yields a blue colour on the addition of sulphuric acid—all phenomena which point to a nitroso derivative.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the treatment of sewage, night-soil, and towns'-refuse, and like matters to utilise them as manure, and in the production of an artificial fuel to be employed in the said treatment, and for other purposes. William Henry Hughan, Southport, Lancaster. June 5, 1874.—No. 1959. The petitioner throws into closets, sewers, or sewage-tanks a preserving powder to prevent decomposition, which he calls the sanitary powder; then he adds a second powder, which causes the manurial products to be precipitated, which he calls the precipitating powder; he then drains off the water by downward filtration, and the residuum is mixed with hot superphosphate manufactured in the usual manner, and in about twenty-four hours becomes a dry sewage phosphate manure or night-soil phosphates. The petitioner forms the above-named sanitary powder of portland cement or like materials, sulphates of soda, magnesia, and potash, mixed in oil (mineral oil preferred) until of a consistency of mortar, and decomposed by sulphuric acid, well boiled, and when dry is ready for use. He also manufactures a powder for the same purpose from material such as kainit and seaweed boiled with clay (china preferred) and soda waste, all reduced to pulp until saponified, the mass being then treated with sulphuric acid. The precipitating powder is formed of portland cement or like material with a little fluor spar mixed, soaked, or set in oil, mineral, or the distilled oil from the carbonisation of coal-ashes hereinafter mentioned, until indurated, and then powdered. For use in dry closets the petitioner forms a powder from the carbonisation of coal-ashes in gas revolving-retorts, the gas and oil being collected. The cinders are separated, and the black ash portion is the powder for closets. The contents of the closets and powder are mixed with animal cement powder, viz., farm-yard manure (or rich street-sweepings or sea-weed) triturated in a mill with diluted sulphuric acid (or plaster of Paris), and further incorporated with clay and quartz or sea-weed until capable of being moulded into bricks, which are dried, calcined, closed from, and then burnt in the open air as cement until all the charring has disappeared: the result of the mixture is a rich nitrate manure. The fuel is formed by mixing peat, pulp, sand, and clay with hot Yorkshire or other similar lime, and slaking in closed vessels. The ashes from this fuel form a good portland cement.

Improvements in the manufacture of sulphate of potash, and in apparatus employed therefor. Charles Stuart Gorman, chemist, Irvine, Ayr, N.B. June 6, 1874.—No. 1971. The features of novelty which constitute this invention are:—First. Mixing with chloride of potassium, alkali or chrome waste, lime, and magnesia, as and for the purposes described. Second. Introducing the gases and vapours into the decomposing chamber through a pipe extending throughout the chamber before the gases and vapours are allowed to mix with the chlorides, and terminating the gas inlet-pipe in or about the centre of the top or bottom of the decomposing chamber. Third. The employment of metallic oxides unmixed with the chlorides to promote the oxidation of sulphurous acid before it is introduced into the chlorides under conversion. Fourth. The employment of chlorine to promote the oxidation of the sulphurous acid as and for the purposes described. Fifth. The employment of nitric acid to promote the oxidation of the sulphurous acid as and for the purposes described.

Improvements in the treatment of sugar and cane juice. James Duncan, sugar refiner, Mincing Lane, London. June 8, 1874.—No. 1989. The reduction of the glucose in sugar by means of lime and the precipitation of the lime by means of sulphuric acid as hereinbefore described; also the neutralisation of the free acids arising in the course of the foregoing process by means of carbonate of lime.

Improvement in the preparation of products of aniline, and matters from which aniline is or may be derived, suitable to be used in dyeing and printing, and in the preparation of colouring matters. John Casthelaz, manufacturing chemist, Crumpsall Vale Chemical Works, near Manchester, Lancaster. June 10, 1874.—No. 2009.—According to this invention aniline or nitrobenzine is treated with sulphuric acid in excess, and with bichromate of potash or other oxidising agent with or without heat. From the product a soluble colouring-matter can be extracted, which imparts a brown tint to woollen or other matters, the said brown tint changing to black when the dyed matters are treated with a bath of bichromate of potash, followed by an alkaline bath. Chromic acid, or ammoniacal solution of copper, or salt of copper, and several other agents may be substituted for the bichromate of potash; aniline black is also obtained by heating this product, or emeraldine, or other insoluble aniline black along with an excess of aniline, and with or without chlorhydrate of aniline or other aniline salt. The product is soluble in alcohol, and may be rendered soluble in alkali or water by heating with sulphuric acid.

Improvements in the manufacture of sulphate of soda and sulphate of potash. William Hunt, manufacturing chemist, of Castleford, near Normanton, York. June 10, 1874.—No. 2016. According to this invention the chloride of sodium (common salt) or chloride of potassium, before it is decomposed in the chambers by a mixture of sulphurous acid gas, steam, and air, is made or moulded into layers or blocks, and perforated with a series of holes at short distances apart. By means of these perforations the direct entrance of the gaseous mixture into the interior of the layer or block is secured, greater surface for the gaseous mixture to act upon is produced, and the draught of the gaseous mixture through the chambers is less impeded than when the lumps operated upon are solid. The decomposition of the salt is effected in less than one-half the time required in the ordinary process, and finely ground rock-salt may be advantageously employed.

Improvements in the manufacture of sulphates, and in apparatus employed therein. James Hargreaves, chemist, and Thomas Robinson, ironfounder, both of Widnes, Lancaster. June 10, 1874.—No. 2018. This relates to further improvements in and in connection with the patentees' direct action process of producing sulphates of soda and potassa, or either of them. First. For preventing loss of heat by radiation from the sulphurous acid flues, the arch or covering connection between the chambers is lowered, and the connecting pipe between the sulphurous acid flues is laid in the solid brickwork, and the heated gases conveyed through the said connecting pipe. By preference the said connecting pipe is laid below the circulating pipe at one end of the sulphate chambers. Second. For keeping cool the bearings of rotary exhausting apparatus employed in the manufacture of sulphates we form the bearing brackets hollow at a distance from the sides, and cause a current of water to flow through the said hollow bearings. We also use oil or other lubricant over and over by pumping or raising it, and allowing it flow over the bearings. Third. Instead of using a syphon to take the products of combustion into the chambers when heating chloride with the products of combustion, we employ a cover for the feed-hole of such form that an annular passage is left around the feed-hole, and we cause the products of combustion to flow through the said annular space and through the feed-hole. By reversing the current of gas we cause the remaining sulphurous acid and steam to pass through the said feed-hole and annular opening previous to discharging a chamber. Fourth. For preventing gases from passing through the walls of brick chambers we build into the said walls plates of iron or other metal.

Improvements in the treatment of animal charcoal used in the decolorisation of sugar solutions. Charles James Crossfield, and James Barrow, sugar refiners, and Edmund Alleyne Cook, analytical chemist, all of Liverpool, Lancaster. June 10, 1874.—No. 2024. This consists essentially in so treating spent or used charcoal as to produce pyrophosphate therein.

Improvements in the manufacture of soft white soap. Gerard Joan Jacobson, Opollo Stearine Works, Schiedam, Holland. June 10, 1874.—No. 2030. A very useful household soap is made of oleine (oleique acid) mixed with soda or kalie lye and hot water in the quantities specified as follows:—2 gallons of distilled oleine, 1 gallon of lye, 5 gallons of hot water. While pouring the hot water into the oleine the mass should be constantly stirred, and at the same time the lye must be slowly dropped in; stirring must be continued until the whole mass has assumed the appearance of a thick yellowish soap without curdles. After twenty-four hours' rest the soap is perfectly white and ready for use.

Improvements in preserving fresh uncooked meat and other animal food, and antiseptic mixtures for that purpose. Alexander Herzen, doctor of medicine, Florence, Italy. June 11, 1874.—No. 2032. This invention relates to the preservation of fresh uncooked meat and other animal food in its natural condition, without change of colour or flavour, by immersing it for a time in a solution of a mixture of boracic acid, borax, salt, and saltpetre, and then packing it, preferably in fat of the same kind.

MEETINGS FOR THE WEEK.

MONDAY, 5th.—Medical,
—— London Institution, 5.
—— Royal Institution, 2. General Monthly Meeting.
TUESDAY 6th.—Civil Engineers, 8.
—— Zoological, 8.30.
—— Royal Institution, 3. Prof. Duncan, "On the Grander Phenomena of Physical Geography."
WEDNESDAY, 7th.—Society of Arts, 8.
—— Pharmaceutical, 8.
—— Microscopical, 8.
THURSDAY, 8th.—Royal Institution, 3. Prof. Seeley, "On the Fossil Forms of Flying Animals."
—— Royal, 8.30.
FRIDAY, 9th.—Royal Astronomical, 8.
—— Quekett Club, 8.
—— Anthropological, 7.30.
—— Royal Institution, 8. Weekly Evening Meeting. 9. Sir William Thomson, "On Tides."
SATURDAY 10th.—Royal Institution, 3. Mr. G. Smith, "On the History of Assyria."
—— Physical, 3. Prof. H. M'Leod, "On an Experiment Illustrating the Want of Achromatism of the Eye." J. Barrett, "On a Form of Mercurial Air-Pump."

THE CHEMICAL NEWS.

VOL. XXXI. No. 807.

SHORT NOTICES OF SOME CORNISH MINERALS.

By Professor A. H. CHURCH, M.A., &c.

1. *Steatite.*—A year or more ago I obtained from Mr. Richard Talling, of Lostwithiel, some small specimens of a very pretty pink variety of soapstone. It presented a considerable resemblance to certain pink figure stones from China, but exhibited a rather more saliny lustre in places, while in other spots it was more sub-translucent. Its hardness was above 1 on the surfaces of the plates and fibres of which the mineral consisted, while in a direction at right angles to these fibres the hardness exceeded 2. The specific gravity was 2·70. The mineral, on analysis, proved to be a hydrated magnesium silicate, with mere traces of alumina, iron, and manganese. It contained less than 1 per cent of hygroscopic water; removed either over sulphuric acid *in vacuo*, or at 100° C. The dry mineral gave the following percentage:—

Magnesia	32·89
Silica	63·18
Water	4·47
	100·54

These numbers point very clearly, I think, to a simple and satisfactory expression for this mineral. The formula, $3MgO,H_2O,4SiO_2$, requires these percentages:—

$3MgO$	=	120	= 31·75
$4SiO_2$	=	240	= 63·49
H_2O	=	18	= 4·76
		378	100·00

It is a silicate of magnesia, in which one-fourth of the magnesia is replaced by water. Analyses 10, and 12 to 22 in Dana's "Mineralogy," p. 453, referring to similar minerals from different localites, also agree well with the above formula. In other analyses, likewise referred to talc by Dana, the divergences can often be explained on the supposition of the presence of about 1 per cent of hygroscopic moisture, and the replacement of some of the magnesia by ferrous oxide. Some experiments now in progress on saponite, pagodite, and agalmatolite will, I hope, clear up some remaining difficulties connected with the so-called soapstones.

2. Not many months ago I received from Mr. Talling a nearly white crystalline mineral, which I have been unable to identify with any known species. It occurs in short, silky crystals, implanted on a translucent pale green vitreous substance, not unlike allophane. The crystals there have a slight greenish hue resembling that of ferrous sulphate. The quantity received as yet has been sufficient merely for a qualitative examination. The mineral contains much water, some fluorine, and a good deal of silica, and of ferrous oxide. It loses 15·14 per cent of its weight at 100° C., and 20·24 per cent at a red-heat; the total loss thus amounting to no less than 35·38 per cent.

3. *Native Gold* from Cornwall. Some grains of gold from Ladock gave, on analysis,—

Gold	92·34 per cent.
Silver	6·06 ,,
Iron	trace
Silica and loss ..	1·60 ,,
	100·00

4. *Native Silver.*—A beautiful old specimen of native silver from Huel Herland recently came into my possession. It was filiform, and of specific gravity 10·38. On analysis I obtained—

Silver	99·05 per cent.
Iron	0·59 ,,
Loss, &c.	0·36 ,,
	100·00

The iron found might, in part at least, be due to a trace of iron pyrites, which also occurred in the matrix of the specimen. Neither gold nor copper were present.

ON SOME PROPERTIES OF NITRO-GLYCERIN $[C_3H_5(NO_2)_3O_3]$.

By SERGIUS KERN, St. Petersburg.

STUDYING now the properties of some explosive substances, I think this preliminary notice on nitro-glycerin will be of some interest. The nitro-glycerin for the experiments was prepared in the ordinary way, only the apparatus was slightly altered. The glycerin ($C_3H_8O_3$) was poured into a funnel, 5 grms. capacity, with a long glass tube and a tap near the neck of the funnel. The mixture of equal quantities of fuming nitric and sulphuric acids was poured into a high glass surrounded with another filled with water. The glass tube of the funnel was next introduced into the acid mixture, and the tap was opened. Then, as the glycerin flowed into the mixture, it was quickly stirred together by the same funnel-tube. The operation finished, all the liquor was poured into a deep glass vessel filled with water; the nitro-glycerin sunk was collected and dried over sulphuric acid under a glass bell-jar. The nitro-glycerin obtained was nearly colourless with a light yellow tint. The sp. gr. was found to be 1·6 at 15°; it solidified only at −4° in a crystalline mass.

At the following temperatures nitro-glycerin underwent the following modifications:—

187°—ebullition; separation of orange vapours.

220°—strong explosion.

262°—the most strong explosion.

294°—very feeble explosion, accompanied with a yellowish flame.

It is seen from this small table that the explosive properties of nitro-glycerin nearly disappeared at a high temperature.

LECTURES ON THE MORPHOLOGY OF CRYSTALS AT THE CHEMICAL SOCIETY.

By NEVIL STORY MASKELYNE, M.A., F.R.S., &c.

(Continued from page 121).

LECTURE XII.

THE symmetrical system next passing under review was that in which two original planes of symmetry intersect at an angle of 60°. Two such planes will result in a third plane of symmetry inclined on each of them at 60°; and if we first consider the repetitions that, for instance, a pole lying independently on the sphere (that is to say, not engaged with a circle of symmetry) would undergo as the result of the form to which the pole belongs, being symmetrical to these three planes and to a centre, we shall see that it will result in twelve poles, the faces of which would be parallel in pairs and grouped as in Fig. 11, with the form $\{k\,k\,l\}$ where the spots represent the poles as distributed on one hemisphere, and the eyelets those opposite to them on the opposite hemisphere of projection.

It is, however, to be observed that the zone plane perpendicular to the three plane of symmetry itself fulfils the

conditions necessary for a potential plane of symmetry. If, now, we call the first three planes of symmetry, S_1, S_2, S_3, and their zone plane the plane C, and if we suppose the plane C to be actually symmetral, the poles of either hemisphere in the last figure will be repeated on the opposite hemisphere, as in Fig. 12; and one sees at once that we have a series of systematic triangles, *e.g.*, S_3, S_2, C, containing each two poles, so disposed that the whole figure will be symmetrical to a new triad of planes Σ, viz., Σ_3, Σ_2, Σ_1, which will evidently be inclined each at 30° to two, and at right angles to the third, of the planes S. Thus a symmetrical system, in the former case trigonal in symmetry, becomes a system hexagonal in symmetry without the introduction of any new condition that was not involved in the first case. The sphere will be divided, in the latter case, into twenty-four systematic triangles, with their sides, S and Σ, quadrants, and their angles, s σ, right angles, while their side $C = \frac{\pi}{6}$, and their angle $= c$ 30.

Hence, the general scalenohedron of this form will have twenty-four faces.

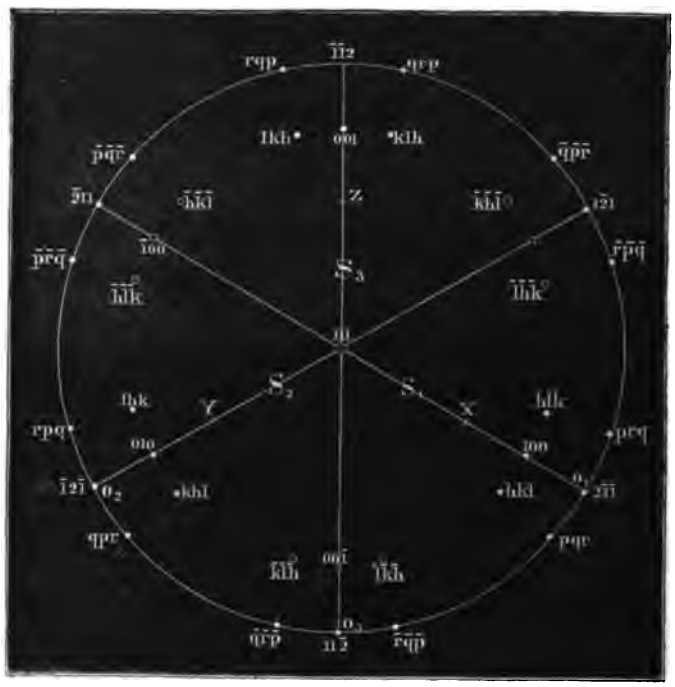
The selection of an axial system for hexagonal crystals presents some difficulties. The system adopted by Professor Miller has, however, this advantage, in point of geometrical simplicity, over that of the crystallographers who take four axes, viz., the normals of the planes Σ and C, that the latter have a redundant axial element to deal with; and it further presents the symbols of the forms in the system in a more symmetrical manner than that of an "ortho-hexagonal" axial system proposed by Schrauf, in which the normal to the plane C, and two of the perpendicular axes of symmetry lying in that plane, serve for the axes, the parameters on the two latter being in the relation $\frac{1}{\sqrt{3}}$, one of the planes of symmetry being a parametral plane. The axial system of Professor Miller is formed by three edges lying in the planes of symmetry, S, equally inclined upon the morphological axis normal to the plane C. These axes are parallel to the edges of a rhombic hexahedron, or rhombohedron. The parametral plane of the system will be one parallel to the plane C, and will obviously intersect with the axes with equal parameters. Such an axial system, therefore, will be represented by the expression—

$$\xi = \eta = \zeta;\ 1, 1, 1,$$

in which the only variable element is that single angle at which the three axes are inclined to one another.

The assignment of symbols to the seven kinds of forms of the system will not be difficult. If we commence by treating the form with faces parallel to the plane C as the parametral plane $\{1\,1\,1\}$ the poles of the axial planes, X Y, Y Z, Z X, will evidently lie on the great circles, S and will have the symbols (001), (100), and (010).

FIG. 11.



The pole in which a great circle passing through the poles (111) and (100) would intersect with the zone circle [S Σ] of the planes S and Σ, *i.e.*, the zone circle [1 1 1], is obviously, by the zone rule, $(2\,\bar{1}\,\bar{1})$. While, further, any pole lying on the great circle, S, must fulfil the condition $k=l$, and its symbol will be $\{h\,k\,k\}$. Since the pole $(2\,\bar{1}\,\bar{1})$ is that of the zone circle Σ, the symbol of Σ_1 is seen to be $[2\,\bar{1}\,\bar{1}]$, and a pole on this great circle must fulfil the condition—

$$2h - k - l = 0, \text{ or } h = \frac{k+l}{2},$$

and by the zone rule the great circles [C] and [Σ], will intersect in a pole $(0\,1\,\bar{1})$; and, further, a pole lying on the great circle, [C], *i.e.*, on [1 1 1], must satisfy the condition $p+q+r=0$.

We have then determined the symbols for each of the different kinds of forms of this system. Thus, recapitulating these results, the general form, the poles of which lie within the systematic triangle, is a twenty-four faced scalenohedron, which we shall term the di-scalenohedron. Its symbol will be $\{h\,k\,l, e\,f\,g\}$, where the second member

of the symbol represents the poles equidistant with the poles $\{h\,k\,l\}$ from the poles of the form (1 1 1) on the same zone circles, and of these the symbols are easily obtained by the problem of four tantozonal planes. They are—

$$e=2(k+l)-h.$$
$$f=2(l+h)-k.$$
$$g=2(h+k)-l.$$

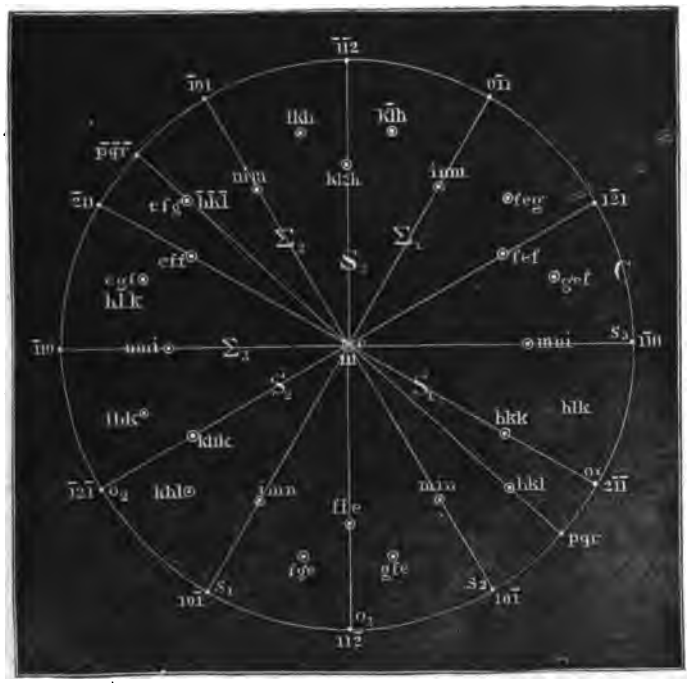
The form, of which the poles lie on the sides, S, of the systematic triangles, will have the symbol $\{h\,k\,k,\ e\,f\,f\}$; it is the di-rhombohedron, and consists of two correlative rhombohedra building up a double pyramid, its faces being sosceles triangles. The poles that lie on the Σ sides of the systematic triangles will belong to forms similar to the preceding, but in no case congruent with them; the symbol of such a form is $\{m\,i\,n\}$, where the index, i, is the arithmetic mean of the other two. The form of which the poles lie on the sides C of the systematic triangles is a di-hexagonal prism; twelve-faced, with its alternate edges alike and its adjacent edges dissimilar. Its symbol is $\{p\,q\,r\}$, and the sum of its indices is zero, since its poles lie on the zone-circle [1 1 1], and fulfil therefore the condition $p+q+r=0$.

The form with its poles at the angles in which S and C intersect is the proto-hexagonal prism; its symbol is $\{2\,\bar{1}\,\bar{1}\}$. The deutero-hexagonal prism, $\{1\,0\,\bar{1}\}$, has its poles, as we have seen, in the intersections of the sides Σ and C; and, finally, the hexagonal pinakoid is the two-faced form, $\{1\,1\,1\}$, lying at the intersections of the sides S and Σ.

Of the numerous mero-symmetrical forms of this system, the general characters of which were described by the lecturer, two in particular were considered which belonged to the hemi-systematic variety. The first presented symmetry only to the planes S and to a centre, the other only to the planes C and to a centre. The former of these, conspicuous examples of which are furnished by calcite and a very large number of minerals crystallising in this system, represents the rhombohedral kind of hemi-symmetry; its symbol is the general form $\pi\{h\,k\,l\}$. The scalenohedron and the rhombohedron are forms that belong to it. The second kind of hemi-systematic forms, denoted by the symbol $\phi\{h\,k\,l,\ e\,f\,g\}$, is the gyroidal kind, and is illustrated by the mineral apatite. Forms hemimorphic on the plane C were exemplified in the mineral tourmaline.

The various kinds of tetartohedral forms were next discussed, the kind represented by the symbol $\alpha\pi\{h\,k\,l\}$ and $\alpha\pi\{k\,h\,l\}$ being represented on quartz, the one by crystals presenting dextro-gyral, the other by crystals presenting lævo-gyral, action on a plane polarised ray of light; and, finally, the unique case in crystallography of a tetarto-systematic form was illustrated by the crystals of dioptase and phænakite presenting the forms $\phi\pi\{h\,k\,l\}$.

Fig. 12.



ON THE MANUFACTURE OF CAUSTIC SODA.*

By JOHN MORRISON, F.C.S.

(Concluded from page 146.)

The percentage composition of the three qualities of caustic soda usually sold is about the following:—

	White 60 per cent.	White 70 per cent.	Cream 60 per cent
NaHo ..	70·00	82·00	70·00
Na_2CO_3 ..	6·00	5·00	5·00
NaCl	18·50	7·00	7·00
Na_2SO_4 ..	5·50	6·00	2·00
Water ..	—	—	15·80
Insol. in water	—	—	0·20
	100·00	100·00	100·00

* A Paper read before the Newcastle-upon-Tyne Chemical Society.

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I have remarked that if on packing a batch of caustic soda the slightest turbidity appear, the finished product will on cooling be very inferior. If a drum of such caustic be broken up, the section will probably show a white ring or corona, where the mass has first cooled, but which gradually changes to a dirty grey towards the central or last solidified portion. And it might be fairly imagined by any one inspecting a drum of this unsatisfactory character, that samples taken from the bad core would produce either a tinted solution, or would contain a pretty fair amount of insoluble matter. Such, however, is not usually the case, for even the most hopelessly bad pieces generally give, together with a perfectly colourless solution, the veriest trace of a beautiful white sediment consisting of lime. Occasionally, however, a little iron is present, but the two combined rarely exceed $\frac{3}{10}$ to $\frac{4}{10}$ of a per cent. Sometimes also alumina separates on neutralising the clear liquor with an acid, showing aluminate of soda to have been present. This latter is not a little singular, for the bottoms invariably contain alumina, and why the caustic soda should at an odd time take up a portion seems rather curious. Sometimes in inferior looking samples of caustic soda the aluminate is present without any other impurity exhibiting itself, which would go to prove the insolubility of aluminate soda in the concentrated hydrate.

The caustic drums should never be packed straight ahead till completely full, but by three or four instalments. In the former case, as it cools, it contracts or withdraws from the centre, leaving a hollow core right through the axis of the drum, and causes a loss in drums of nearly 10 per cent, equal to 1s. 6d. to 2s. per ton of caustic soda.

In the manufacture of caustic soda, the water employed is an item of considerable importance, for in the production of every ton of 70 per cent, no less than 14½ tons water must be converted into steam; and it is rather strange that, with one or two solitary exceptions, not the slightest attempt is made to utilise the enormous waste and loss of heat. I feel quite satisfied that by judiciously fixing a hood over the boat-pans or caustic pots, communicating with some simple description of surface condenser, not only could a considerable amount of water be saved, but the expenditure of steam for causticising, &c., might be also materially lessened. But it requires a little courage on the part of managers to move out of the beaten track, for in Lancashire especially there is little sympathy with failures.

The production of salt cake (including "bottoms," if sold) is, in well-conducted works, 54 to 57 per cent of 60 per cent caustic soda, and the proportion of "bottoms" is 9 to 11 per cent of the good caustic. If, however, much "red" liquor from the soda ash department be used, this proportion will be larger, or say 12 to 14 per cent.

The amount of salt necessary for reduction to 60 is 15 to 16 per cent of the caustic soda packed, though it varies considerably; and the amount of nitre is 1½ to 2 per cent. Reckoning, however, ½ to be recovered in the form of caustic alkali, the real loss only amounts to ¾ to 1 per cent. The total quantity of fuel for all purposes should not exceed 6 to 6½ tons, but in many works the consumption is over 7 tons per ton of caustic soda. It may be divided as follows:—

		Tons.	Cwts.	Qrs.
B. A. Furnaces	Mixing	1	0	0
	Firing	2	0	0
	Boat-pans ..	2	0	0
	Caustic pots ..	1	0	0
	Boilers	0	10	0
	Total	6	10	0

The raw materials and total expenses per ton of 60 per cent may be put down as follows:—

	£	s.	d.
Fuel, say 6½ tons, at 7s. 0d.	2	6	6
Salt cake, 37 cwts. ,, 3s. 3d.	6	0	3
Limestone, 22 ,, ,, 0s. 4d.	0	7	4
Lime, 11 cwts. at 1s. 0d.	0	11	0
Salt, 3 ,, ,, 0s. 8d.	0	2	0
Nitre, 40 lbs. ,, 0s. 1½d.	0	5	0
Wages	2	0	0
Water	0	1	6
Drums	0	16	0
Charges and shipment	0	15	0
Office expenses and management	0	5	0
Interest on capital, depreciation, stores, &c. ..	0	16	0
Total cost *f.o.b.* Liverpool	£14	4	7

I have but briefly entered into the manufacturing details of cream caustic soda, my desire being principally to describe minutely those of white. The colour is due to the presence of peroxide of iron, which is held in solution or suspension by the soda at its comparatively low finishing temperature, but which separates on solution of the caustic in water. Tate suggests the presence of ferrate of sodium, which would be decomposed on treatment with water.

If the cream caustic be prepared from uncausticised "red" liquors, a considerable quantity of nitre is necessary, namely, about 1 cwt. per ton of soda produced. In the latter case, also, much less fuel is required, as in place of being evaporated down from about 15° T. the concentration of the liquors only commences at about 60°, that being their average strength.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, Tuesday, March 30th, 1875.

Professor Odling, F.R.S., President, in the Chair.

The President, Dr. Odling, in his annual address, congratulated the Fellows on the satisfactory state of the Society; the number of Fellows was now 801, 84 having joined the Society during the past year, whilst, by removals, resignations, and deaths, they had lost 16. The names of the Fellows deceased were Thomas Anderson, M.D., T. W. Burr, H. Dircks, D. Hanbury, F.R.S., F. C. Matthews, Henry Matthews, Henry Medlock, Ph.D., Mr. J. Starks, and Col. P. Yorke, F.R.S. The communications made to the Society during the past year were 65 in number, the largest ever sent in in any year since the foundation of the Society. The President then alluded to the very successful Faraday lecture recently delivered by Dr. Hofmann, and, on behalf of the Society, tendered his thanks to Professor Nevil Story Maskelyne, for the course of lectures on Crystallography which he had given.

In evidence of the greatly increased activity of the Society, he might say that the average number of Fellows in the three years ending March, 1872, was 586, and the number of communications 30 per annum; whilst in the three years ending March, 1875, the number of Fellows was 739, and the number of communications had increased to 59. The development of chemical industry in its application to the manufacture of so-called organic products had been very striking during the last twenty years, and thus the practical fruit of the pursuit of abstract chemical science had again largely contributed to the progress of abstract investigation, since many of the compounds, manufactured on a large scale, are amongst the most valuable raw materials of the scientific chemist.

The analytical methods for the detection of food adulteration which, with few exceptions, had long been in a most unsatisfactory condition, are now being replaced by others more trustworthy and more accurate. With regard to the general policy of adulteration acts, however, it should not be forgotten that legislative interference with manufactures of any kind was far from conducive to manufacturing progress.

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The Treasurer then read his report, from which it appeared that the removal to the new rooms involved a large increase in the ordinary annual expenditure, and although, at present, the ordinary expenses somewhat exceeded the income, this will soon cease to be the case, from the increase in the number of Fellows.

The election of Officers and Council was then proceeded with, Mr. J. Williams and Mr. E. C. Nicholson being appointed Scrutators. The following is a list of the officers elected for the ensuing year:—

President—F. A. Abel, F.R.S.

Vice-Presidents who have filled the office of President—Sir B. C. Brodie, F.R.S.; Warren De la Rue, D.C.L., F.R.S.; E. Frankland, D.C.L., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; W. Odling, M.B., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S.; A. W. Williamson, Ph.D., F.R.S.

Vice-Presidents—J. H. Gilbert, Ph.D., F.R.S.; J. H. Gladstone, Ph.D:, F.R.S.; A. Vernon Harcourt, M.A., F.R.S.; G. D. Longstaff, M.D.; J. Stenhouse, Ph.D., F.R.S.; A. Voelcker, Ph.D., F.R.S.

Secretaries—W. H. Perkin, F.R.S.; H. E. Armstrong, Ph.D.

Foreign Secretary—H. Müller, Ph.D., F.R.S.

Treasurer—W. J. Russell, Ph.D., F.R.S.

Other Members of Council—J. Attfield, Ph.D.; Dugald Campbell; J. Dewar, F.R.S.E.; M. Foster, M.D., F.R.S.; David Howard; Nevil Story Maskelyne, F.R.S.; E. J. Mills, D.Sc.; J. A. Phillips; Hermann Sprengel, Ph.D.; R. V. Tuson; R. Warington; C. R. A. Wright, D.Sc.

Dr. Siemens then proposed a vote of thanks to Professor Odling, the retiring President, which was seconded by Mr. J. Tennant, and carried by acclamation.

Dr. Odling having made a suitable reply,

Mr. A. Smee proposed, and Mr. J. Newlands seconded, a vote of thanks to the Officers and Council, which was responded to on their behalf by the Senior Secretary, Mr. W. H. Perkin.

After the usual vote of thanks to the Auditors, proposed by Professor Abel, and seconded by Mr. J. Spiller, the meeting was adjourned until Thursday, April 1st.

Thursday, April 1, 1875.

Professor Abel, F.R.S., President, in the Chair.

The minutes of the preceding meeting having been read and the visitors announced, the following names were read for the first time:—J. E. Stoddart, W. M. Hamlet, H. M. Hastings, H. S. Carpenter, A. Southall, and W. A. Little. For the third time, Messrs. Arthur Taylor, M. G. Crossman, Charles A. Heywood, Samuel A. Hill, Edward Lawrence Cleaver, R. Elliott Cunnington, Cornelius O'Keeffe, Matthew W. Williams, James Wilson, and George E. Davis. Messrs. Thomas Howard and J. Ackworth were formally admitted Fellows of the Society.

The newly elected President said, that before proceeding to the usual business of the meeting, he wished to express the profound gratitude he felt for the honour the Society had conferred on him by electing him as their President. He would endeavour, to his utmost, to uphold the character of the Society; but the distinguished chemists who had preceded him in that office, and especially the one he had immediately succeeded, whose grasp of the philosophic bearings of any subject, and aptitude in detecting points for discussion, had formed one of the great attractions of their meetings, rendered this especially difficult. They might rest assured, however, that the interests of the Society would be zealously watched and warmly cherished, as long as he held the office of President.

The first paper, "*Researches on the Action of the Copper-Zinc Couple on Organic Bodies* (Part VIII., *On Chloroform, Bromoform, and Iodoform*)," by Dr. J. H. Gladstone and Mr. A. Tribe, was read by the latter. The dry couple has no action on chloroform, but when heated with it in the presence of absolute alcohol, gas is rapidly evolved, which, on examination, proved to be marsh gas, mixed with a small amount of acetylene. Chlorethylate of zinc is left in the flask, so that the reaction may be represented by the equations—

$$CHCl_3+3C_2H_3O.H+3Zn=C\ H_4+3C_2H_5O.ClZn.$$
$$2CHCl_3+3Zn\qquad\qquad =C_2H_2+3ZnCl.$$

With water the action is somewhat similar, marsh gas and zinc oxychloride being produced—

$$2CHCl_3+3H_2O+6Zn=2CH_4+3(ZnCl_2,ZnO).$$

With bromoform and absolute alcohol the result takes place after a few minutes with almost explosive violence, so that it is necessary to immerse the flask in cold water. The results are similar to those obtained with chloroform, but the proportion of acetylene produced is much larger.

When zinc foil is substituted for the couple the reaction is nearly the same, but the amount of marsh is larger.

Iodoform gives results very similar to those obtained with bromoform, but the reaction is not nearly so violent.

Mr. W. H. Perkin said it was remarkable that no intermediate chlorinated compounds were produced in this reaction, as was the case when chloroform was treated with zinc powder, especially since their volatility would at once remove them from the further action of the couple.

In reply to a question of Professor Tilden,—

Mr. J. Williams said the best method of preparing bromoform was by the action of alkalies on bromal.

The President, having thanked the authors in the name of the Society,—

Dr. W. A. Tilden read a paper "*On the Action of Nitrosyl Chloride on Organic Bodies* (Part II., *On Turpentine Oil.*") When nitrosyl chloride, evolved from the sulphate and common salt, is poured into oil of turpentine, it becomes hot, and much brown resinous matter is produced; but if the liquid be kept cool by a freezing mixture, a white odourless powder is produced, which is nearly insoluble in cold alcohol, and cannot be re-crystallised without undergoing decomposition. It has the composition $C_{10}H_{16}NOCl$, and when treated with an alcoholic solution of soda, loses the elements of hydrochloric acid, and yields *nitrosoterpene*, $C_{10}H_{15}NO$, a beautiful colourless crystalline compound. It melts at about 130°, dissolves readily in a hot solution of soda, and crystallises from it unchanged. It is not reduced by alcoholic sulphide of ammonium, but with sodium amalgam it gives free ammonia and a hydrocarbon. It unites with bromine to form a crystalline addition product, $C_{10}H_{15}NOBr_2$, and when heated ro 180° with turpentine or benzene, it yields a waxy granular substance, having the same composition as the original body, with which it is probably polymeric.

The President said they were much indebted to the author for his very interesting communication, and he should be glad to hear any remarks that members might have to make on the subject.

Dr. Hofmann was glad that the importance of the reduction of this body had not escaped the notice of Dr. Tilden. He had found that substances which resisted the ordinary method of treatment with an alcoholic solution of sulphide of ammonium yielded at once to that reducing agent, when heated with it for a few hours in a sealed tube.

Professor Tilden, in reply to a question put by Dr. Armstrong, said he had not studied the action of oxidising agents on the compound, as, from its great alterability, he did not expect satisfactory results.

Dr. Hofmann said he had recently occupied a considerable time in reading the papers of Liebig, and had derived great advantage from their study. He could recommend their perusal to chemists for the value of the suggestions thrown out and the number of experiments alluded to, which were well worth taking up. Amongst these were his early papers on the fulminates. Liebig

was struck with the identity in composition between fulminate and cyanate of silver, and had a great desire to find some cyanogen product amongst the products of decomposition, and in many places states his conviction that urea would be found. Dr. Steiner, who has recently worked on this subject in the Berlin laboratory, finds that urea is one of the most frequent products of the decomposition of the fulminates. Aniline was first tried; this acts violently on the fulminates, yielding two substances, one of which is monophenyl urea and the other diphenylguanidine; with toludine similar substances are produced. The action of ammonia itself was then examined, and it was found that when the fulminate is heated with it, it at once yields urea and guanidine. These, however, are only the ultimate products; for if mercury fulminate be digested with ammonia at a low temperature, a compound

$$Hg'' \begin{cases} C.NH_4.NO_2.CN \\ C.NH_4.NO_2.CN \end{cases}$$

is formed, and this, when heated, gives besides urea and guanidine, various substances, which crystallise with the greatest facility, amongst which he might mention two bodies having the composition $C_7H_{13}N_{11}O_3$ and $C_6H_{11}N_9O_3$. Again, Dr. Gladstone, many years ago in Liebig's laboratory, tried the action of sulphuretted hydrogen on silver fulminate, and obtained ammonium sulphocyanate. These experiments were afterward repeated by Kekulé, who found, however, that only a portion of the carbon went to form the sulphocyanate, another portion being given off as carbonic acid. Dr. Steiner has recently passed sulphuretted hydrogen through mercury fulminate, suspended in anhydrous ether; mercury sulphide is formed, and the ethereal solution, when allowed to evaporate spontaneously, leaves a residue consisting of ammonium sulphocyanate and a magnificent white crystalline substance, $C_5H_8N_4O_6S_2$, which is insoluble in water, and is left behind when the product is treated with water. This new compound only exists at temperatures below 24°, above that temperature it splits up with violent ebullition, thus:—

$$C_5H_8N_4O_6S_2 = 2NH_4CNS + 3CO_2.$$

It is perhaps formed from fulminic acid, thus:—

$$6CHNO + 3H_2S = C_5H_8N_4O_6S_2 + CNS.NH_4.$$

The other communication he had to make was a simple experimental illustration, to show that when chlorine displaces oxygen, only one volume of the latter is liberated for every two of the former absorbed. It was well known that when a solution of chloride of lime was heated with a little sesquioxide of cobalt, or nickel oxygen was evolved, so that if chlorine were passed into a boiling solution of caustic soda containing some of the sesquioxide suspended in it, it would be absorbed, and oxygen given off. A long tube, about a metre in length, sealed at one end and closed at the other with a stopcock is filled with chlorine, and then about 20 or 30 cubic centimetres of soda solution, containing suspended in it some freshly precipitated sesquioxide of nickel, is allowed to run in. If the tube be now heated in a water-bath, and, when cold, the stopcock is opened under water, it will rush in until the tube is half full. The two volumes of chlorine have disappeared, and the one volume of gas now in the tube will be found to be pure oxygen.

Dr. Armstrong said that for some months past he had been working on the fulminates, and he believed that Kekulé's formula, $C.NO_2.CN.H_2$, which made fulminic acid the nitro-derivative of cyanomethane, was not so well founded as was generally supposed. Meyer, by the action of nitrous acid OH.NO on secondary nitropropane, $C(CH_3)_2H.NO_2$, obtained a body $C(CH_3)_2.NO.NO_2$, but the action was different with primary nitropropanes; the ethyl compounds, for example, yielded $C(CH_3)(NOH)NO_2$. It seemed probable that fulminic acid was not a nitro-derivative, but perhaps a compound NO.HC=C(NOH)". The results obtained in Dr. Hofmann's laboratory might perhaps be explained on this hypothesis, but they would no doubt lead to the elucidation of this matter. He himself intended to study the action of bromine on the fulminates, in hopes of obtaining a compound—

$$NO.Br(C=C(NOBr''),$$

but this would most probably be unstable, and be at once changed into NO.BrC=CBr.NO.

Dr. Hofmann said, it should be remembered that Kekulé had not only proved that chloropicrin is produced by the action of chlorine on the fulminates, but also that chloride of cyanogen is formed; if, however, they went on investigating the matter at Berlin, and Dr. Armstrong did so here, they would doubtless arrive at some definite notion of the constitution of the fulminates.

The meeting was then adjourned until Thursday, April 15th, for which the following papers are announced:—(1) "On the Gases Enclosed in Coals from the South Wales Basin," by J. W. Thomas; (2) "On Narcotine, Cotarnine, and Hydrocotarnine," by G. H. Beckett and Dr. C. R. A. Wright; (3) "Note on Isomeric Change in the Phenol Series," by Dr. H. G. Armstrong; (4) "On Andrewsite and Chalkosiderite," by Professor Nevil Story Maskelyne; (5) "An Examination of Methods for Effecting the Quantitative Separation of Iron Sesquioxide, Alumina, and Phosphoric Acid," by Dr. W. Flight.

SOCIETY OF PUBLIC ANALYSTS.

The following cases of successful prosecution for the adulteration of milk will be found to be of interest to many Public Analysts, involving as they do several points upon which much difference of opinion exists, such as whether abstracting the cream from milk can properly be regarded as an adulteration, and whether the personal attendance of the Analyst, in the absence of any scientific evidence on behalf of the defendant, should be required to confirm his certificate.

It will be seen from these cases that neither in Wales nor in Ireland has the Act of 1872 been allowed to become a dead letter; and it will also be noticed, from the amount of the penalties inflicted, that the magistrates appear to be of a less tender-hearted type, in their feeling towards offenders, than many of the Metropolitan ones.

MILK PROSECUTIONS.

At the Swansea Police Court, a milk dealer was summoned for unlawfully selling, as pure or unadulterated, certain milk which was then and there found to be adulterated, or not pure. Mr. Smith appeared for the defendant. The inspector deposed that on the morning of the 11th day of March he met the defendant, and asked him if he sold milk; he replied "Yes," and he then purchased a pint of him, for which he paid 2½d. He put two-thirds into a bottle which he sealed, and the remaining one-third he put into another bottle, which he sealed and gave to the defendant. He then told him he was going to have the milk analysed, and that he could accompany him to Dr. Morgan with the sample if he chose. He, however, did not do so. Dr. Morgan, the Public Analyst, was then sworn, and handed in his certificate of the result of his analytical test. The sample contained 80 per cent of genuine milk, and 20 per cent of skimmed milk.

Mr. Smith made a powerful defence to the Bench on behalf of the defendant. He said that all the constable bought was milk and nothing but milk, and they were not charged with selling anything but milk. A great deal had been said about adulteration, and he could not for one moment wish to uphold adulteration; but at the same time he must do his duty to his client, and he contended that adulteration could not be by simply taking away one of the component parts. You could not adulterate water by subtracting from it, and so in like manner he contended that they could not adulterate milk by taking away. They could make it less valuable and less pure, but they could not in the strict sense say they adulterated an article by taking away from. According to the best lexicographers!

it meant to debase, to lessen in value, to corrupt, not by abstracting from, but in every sense in which these words were used, by the addition of some foreign matter. He contended that they could not corrupt by taking away. In order to ascertain the correct meaning of the word adulterate, he had referred to what was the meaning of the word debase, and he found that it meant to make impure by the admixture of a baser material; he was also bound to say that the word debase meant to reduce in fineness —purity, quality, or value—but he contended that there were no such words as these made use of in the Act of Parliament. He was quite aware that his client was charged with selling milk which was "not pure," and he contended, first of all, that they had not adulterated in any way, because they had not by admixture put anything to, or altered the character of, the article which they had sold. Secondly, he contended that they had sold what they pretended to sell, viz., milk, and milk only; and there was nothing in the Act of Parliament in reference to the sale of milk, to declare whether they should sell new milk or old milk, or partially so. If a person asked for new milk, then (but he would not say then absolutely) he would be entitled to have the pure article; but he contended, under the circumstances stated, that they could not convict, unless it was proved that the article was adulterated by the admixture of some foreign substance—the Act clearly implied the adding to, or putting into, and not taking away from.

After a little further legal contention, the Bench decided to hear the other cases before giving their decision.

Several other persons were then charged with a similar offence, viz., selling milk which was not pure, *i.e.*, having been deprived to a certain extent of its fatty matter, or cream, by skimming. In one case, the sample analysed by Dr. Morgan was found to contain 64 parts of genuine milk and 36 parts skimmed milk.

The cases having been proved by the sworn certificate of the Analyst, the Bench retired for consultation, and after a short absence, the stipendiary said that two of these cases had been disposed of by giving the doubts which had arisen in favour of the defendants. The others were seven in number; and after hearing the arguments which had been directed to the Bench by Mr. Smith on the statute and the facts, and after considering the evidence as fully as they could, they had come to the conclusion to convict the defendants in the words of the statute. The allegations in the summons was to the effect that the defendants did sell a certain article, to wit, milk, which was not pure. For that offence the Bench would convict them, following the words of the statute. No douht there was a great deal of force in the argument addressed to them on the meaning of the word adulteration. The Bench were of opinion that, if the whole expressions of the statute were taken together which had reference to "adulteration," or "not pure," they would cover the offence with which the defendants were charged. The scientific evidence must be taken as conclusive, unless it was upset upon cross-examination, which had not been done. In the first case (this being a second conviction), he would be fined £10 and costs; and each of the others would be fined £5 and costs. He would also say that, in the case where a fine of £10 was imposed, the Act ordered that an advertisement should be inserted in the local papers notifying the conviction, and that would be done in the usual form. These were the first cases of this exact nature which had come before the Bench, but if any more of a similar character came before them, a much higher penalty would be inflicted. It was a most serious offence to withdraw (either by adding to or subtracting from—both were equally fraudulent) the essential property of the article sold. It was most important that the public should be protected. Parents gave their children milk, which, if pure, was the most healthy and nutritious food which could be given them; but if there were subtracted from it its fatty properties, the child could not get such nourishment as it should, and the milk was obliged to be supplemented by the addition of other food. The Bench were determined to protect the public in this respect, and to see that they really obtained that for which they paid.

At the Antrim Petty Sessions, a milk dealer was summoned at the instance of the Guardians of the Poor of the Antrim Union for that he, on the 2nd day of March last past, at Antrim, in the County of Antrim, did sell as pure and unadulterated to the said complainants a quantity of drink—to wit, new milk, whereas same was adulterated, and not pure, contrary to the statute in that case made and provided, whereby defendant had for said offence forfeited and become liable to pay a penalty not exceeding £20, together with such costs attending proceedings and conviction as to the justices trying the same may seem reasonable.

Mr. A. O'Rorke appeared to prosecute on the part of the guardians, and Mr. Williamson appeared for the defendant.

Mr. O'Rorke stated the case, and having read the summons, said that the prosecution was of a very serious nature—serious so far as it affected the health of the poor people who were supplied with the milk contracted for by the defendant. Under the Poor-Law Code the guardians of the poor had to advertise for tenders for the supply for the different articles used in the different unions, and among these was the contract for new milk. Accordingly on the 9th April, 1874, the Guardians of the Antrim Union issued the following notice or advertisement:— "The Board of Guardians of this Union will, on Thursday, the 30th day of April inst., receive and consider tenders for the supply of new milk (supplemental quantity)—unadulterated—at——per imperial gallon, for twelve months, ending 30th April, 1875. Probable requirements, say from 30 to 40 gallons weekly in summer, and from 60 to 80 gallons weekly in winter. All supplies must, under a penalty, indicate eight degrees of cream on the lactometer, and show a specific gravity of not less than 1·030." In pursuance of that advertisement, a tender was sent in by the present defendant, which tender was accepted, and the requisite sureties entered into for the supply of new milk from the 1st May, 1874, till the 30th April, 1875. The first Act he (Mr. O'Rorke) thought necessary to call the attention of the court to, was the 23rd and 24th Vic., chap. 84, with regard to the adulteration of food and drink. Having read the provisions under which, for adulteration, a defendant was liable to a penalty of £10, he said that the Legislature had passed more stringent measures in the Act of 35 and 36 Vic., chap. 74, which was passed in 1872. Mr. O'Rorke read the sections of this Act, and said that for adulteration the Legislature had been going on providing penalties ranging from 40s. to £10, and under the Act of 1872, the magistrates had power to impose a penalty of £20. Mr. O'Rorke read and commented on the different sections of the Acts of Parliament. The Legislature, he contended, had provided these Acts to meet such a case as the one with which this defendant stood charged. Moreover, the price paid was a very fair one, viz., 1s. per gallon. However, shortly after the contract was entered into, the milk was found not to be of the stipulated quality, and a letter was written to the defendant pointing this out. Notwithstanding their remonstrance, the milk supplied by the defendant continued to be less than the standard contracted for, and on the 15th January the following letter was written:—

Union Office, Antrim, 15th January, 1875.

SIR,—I am instructed by the Board of Guardians to call your attention to the fact, that the new milk supplied by you of late for the use of the workhouse inmates has been ascertained—not only by instrumental tests applied, but by personal examination by the guardians themselves —to be very inferior in quality, as compared with the milk produced by the workhouse cows, and also defective as regards the standard rate of cream and specific gravity prescribed in your bond. Under these circumstances, the guardians feel it their duty to mark their sense of this

default by imposing the penalties set forth in respect of same in the bond from the date of last settlement—viz., 26th December, 1874. The next payment will accordingly be minus the amount of reduction in price, as per ratio prescribed. I am likewise to add that the Board of Guardians will not hesitate to take still more serious notice of any continued default in the quality of milk supplied to the workhouse.

(By order),
H. C. Scott, Clerk of Union.

Standard rate of cream, 8 degs.—Supplies 5¾ degs.
Specific gravity, .. 1·032 degs.— ·Do. 1·022 degs.

Mr. O'Rorke said that the guardians, finding that the amount of cream did not come up to the required standard in accordance with the bond that had been entered into from time to time, deducted from the amount of the account due to the defendant. In one account of £17 5s. they had deducted £4 6s. 3d., and an account of £20 12s. 6d. they had reduced to £14 11s. 6d. For these reductions the defendant gave a receipt, and offered no objection. The milk continuing to be below the terms of the contract, the guardians determined on sending a sample of it to Dr. Hodges for analysis. Mr. O'Rorke said, that according to the 4th section of the Act of the 23rd and 24th Vic., the productions of Dr. Hodges's certificate was made evidence. He would now read Dr. Hodges's certificate.

Mr. Williamson, who appeared for the defendant, objected to the certificate. Dr. Hodges, he submitted, must appear to give evidence in the case.

Mr. O'Rorke—The Act of Parliament says he must not.

Mr. Williamson would allow the certificate to be read, a note being taken of his objection.

Mr. O'Rorke then read Dr. Hodges's certificate, as follows:—

Belfast, March 3, 1875.

I certify that a sample of milk received by me on the 2nd instant, in a bottle sealed with the seal of Antrim Union, was adulterated by the addition of 34 per cent of water, but contained no substance injurious to health. The specific gravity of the milk was 1·022. It gave only 3 per cent of cream, and contained only 7¼ per cent of solid matters, while pure milk of the poorest quality yields 11¼ per cent of solid matters.

John F. Hodges, M.D., F.C.S.,
Public Analyst, Country Antrim.

After reading Dr. Hodges's certificate, Mr. O'Rorke said he could hardly trust himself to comment on the atrocity of this case—the supply of this milk to these unfortunate paupers. He could hardly believe that any person could be found in this country having the hardihood to contract to supply a workhouse with milk, and would send in such stuff as this. He would ask the Court, after they heard the evidence, to impose as high a penalty with costs as the law permitted them to do.

The Master of the Antrim Workhouse was then examined, and said that, on the 2nd of March, he put a quantity of the milk supplied by Mr. Harper into a bottle, and sealed it. He proceeded to Belfast, and delivered this sample to Dr. Hodges.

Witness was cross-examined.—No person interfered with the sample from the time he took it until it was delivered to Dr. Hodges.

The Matron was then examined as to the non-interference with the sample until it went to Dr. Hodges.

Mr. O'Rorke proved to seeing Dr. Hodges writing the certificate.

Mr. Williamson submitted that on two grounds the case for the prosecution must be dismissed:—First, that the certificate of Dr. Hodges could not be relied on as evidence, and that that gentleman should be present to submit himself to cross-examination. Second, that the defendant had entered into a bond with the guardians to supply milk of a certain specific gravity, and in failing to do so they were to impose a penalty. They had inflicted penalties on the defendant, and therefore he could not be punished twice for the one offence.

Mr. O'Rorke replied to Mr. Williamson's arguments, after which—

The Magistrates said they had given this case a great deal of consideration, and they were of opinion that the adulteration had been proved. They decided that Dr. Hodges's certificate was evidence, and according to that certificate the milk was adulterated by the addition of 34 per cent of water. The defendant had contracted to supply pure milk at 1s. a gallon, and of course his profits on that would be according to the quantity of water he put in the milk. Under the 23rd and 24th Vict,, chap. 84, they had come to the conclusion that the defendant should be fined in £5, and also that he should pay £6 16s. costs.

CORRESPONDENCE.

MANUFACTURE OF CAUSTIC SODA.

To the Editor of the Chemical News.

Sir,—In the Chemical News, vol. xxxi., p. 145, Mr. Morrison suggests an experiment should be made with a view of depriving the lime mud of its water and re-burning it so as to use it over and over again. In the year 1840 I worked at it with that object without success; the difficulty is that it falls to powder, and the price of coal in London precluded me from treating it in a reverberatory furnace.—I am, &c.,

J. B. Anderson.

Soap Works, Southwark, April 5, 1875.

DOUBTFUL MINERALS.

To the Editor of the Chemical News.

Sir,—Your correspondent T. A. R., in articles which he has communicated to your Journal, gives me more credit than is my due, and in an uncivil way brings me into collision on a point of trifling importance with the excellent Mineralogist of the British Museum, Prof. Maskelyne.

The system in mineralogical nomenclature of which he complains is not of my making. In his letter (Chemical News, vol. xxxi., p. 107) speaking of the names of species, he says:—"*Chalcopyrite* is authoritatively flashed by cablegram from Yale College," &c., "Dana all the while sheltering himself under the popular notion that the Greek language is the most approved source for names." Now, with the amount of knowledge that becomes well a teacher in science, your correspondent should not have thought of Dana or Yale College, but have written thus:—*Chalcopyrite* is authoritatively flashed by typogram from Beudent's "Traité de Mineralogie" of 1832, Haidinger's "Handbook" of 1845, Von Kobell's "Mineralogy," and also from nearer home, even from Nicol's "Manual of Mineralogy," published at Edinburgh in 1849, from Greg and Lettsom's "British Mineralogy" of 1858, and in fact from nearly all recent works on the subject, Brooke and Miller's excepted, which strangely substituted the still more meaningless *towanite*, and their authors are all alike blockheads. "I half blush to say it," for "*yellow copper ore* is a distinctive expression wherever English is spoken, and those who like it will continue to use it whilst the ore is of any value in the mineral market." That would have decided the thing, for all would have appreciated the force of the argument.

In the adoption of the scientific names of minerals used in my treatise, I have simply followed the best authorities, and the usual law as to priority. The objection urged to names from a Greek or Latin source, is the old one of uninformed minds against all scientific nomenclature. The object secured by such names is uniformity the world

over through all languages. *Copper pyrites, yellow copper ore, cuivre pyriteux, cuivre jaune, kupferkies, gelferze, gelbes kupferkies*, are some of the many names that were used for this species before the science had accepted of *chalcopyrite* for universal use. Works on mineralogy give the common names as well as the systematic; and no mineralogist is ever disposed to quarrel with the miner, or any other person, for saying, as often as he chooses, "yellow copper ore."—I am, &c.,

JAMES D. DANA.

Newhaven, Conn., March 23, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 9, March 1, 1875.

Certain Problems of Molecular Mechanics.—M. Berthelot.—The author describes the butyrate of soda as the starting-point of his considerations, and examines the heat liberated by the anhydrous salt and its hydrates during solution, the successive states of the dissolved salt, and the formation of crystalline hydrates.

Experiments on the Artificial Imitation of Native Magneto-Polar Platinum.—M. Daubrée.—It is well known that certain specimens of native platinum not only act upon the magnetic needle, but are themselves polar, in the manner of true magnets. These native platinum magnets, according to M. de Koksharrow, are capable of withdrawing a considerable quantity of ferruginous grains from the auriferous sand of the Ural after an ordinary load-stone ceases to have any effect. A similar magneto-polar platinum was produced by fusing the metal with a small quantity of iron.

On Magnetism.—Th. du Moncel.—The property of magnetism of not readily penetrating into the whole of a magnetic mass explains easily the law of the proportionality of the attractive forces of electro-magnets to the diameters of their nuclei. This law is in relation with their surface rather than with their mass, and explains the great power which the author has developed in a tubular electro-magnet with a nucleus 10 centimetres in diameter, a tube 1 centimetre in thickness, and with arms 30 centimetres in length. This electro-magnet, with a single Bunsen element, and with only 482 folds of wire of 4 m.m. diameter, exerted an attractive force of 160 kilos. The force was slightly increased with 5 Bunsen elements, but it was not further perceptibly increased even with 20, because the magnetic mass was no longer in relation with the electric energy.

Purple Colouring-Matter derived from Cyanogen.—M. G. Bong.—Already noticed.

Determination of Boracic Acid, and its Separation when found along with Silica and Fluorine.—M. A. Ditte.—Already noticed.

Reciprocal Displacement of the Volatile Fatty Acids.—M. H. Lescœur.

Calculation of the Moments of Maximum Inertia of the Molecules of the Chlorinated Derivatives of Toluene.—M. G. Hinrichs.—A mathematical paper; not adapted for abstraction.

Study of the Amounts of Heat Liberated in the Formation of the Potash-Salts of Certain Acids of the Fatty Series.—M. W. Louguinine.—The author draws the following conclusions:—That the amounts of heat disengaged in the formation of the potash-salts of acids of the fatty series seems to increase as we ascend the homologous series; the two isomeric butyric acids liberate about the same amount of heat, both when dissolved in water and when they react on potash. The two valerianic acids, that from valerian and that obtained by oxidation, liberate also quaniities of heat, which differ little in presence of water.

"Hygrodeik" Psychrometer, Obviating all Necessity for Calculation.—M. Lowe.—Two thermometers, on the same stand, are fitted with a graphic table, which permits the observer to find rapidly the evaluation which he requires.

New Burette.—M. A. Pinchon.—The Pinchon burette is fixed almost horizontally upon two supports. Air is forced gradually in at the top by means of a screw acting upon a caoutchouc receiver adapted to a flexible tube, and the liquid is forced out by drops.

Moniteur Scientifique, du Dr. Quesneville, January, 1875.

Process Employed in the Royal Works of Freiburg for Freeing Sulphuric Acid from Arsenic.—M. F. Bode.—A very valuable paper, which, however, cannot be made intelligible without numerous illustrations.

Determination of Copper and certain other Metals by the Electrolytic Process.—Taken from the *Bulletin de la Societe d'Encouragement.*

Researches on the Methods of Determining Phosphoric Acid, conducted at the Agricultural Station at Halle, on the Saale.—O. Abesser, W. Jani, and M. Maercker.—The results of the authors, as far as the gravimetric methods are concerned, may be summed up as follows:—For precipitation with molybdate of ammonia a quantity of the sample is taken, containing from 0·1 to 0·2 grm. of phosphoric acid. The bulk of the liquid should be from 50 to 100 c.c. The molybdic solution is prepared according to Fresenius, by dissolving 150 grms. molybdate of ammonia in 1 litre of water, and pouring this solution into 1 litre of pure nitric acid. The quantity of solution used should be such, that for 1 part of phosphoric acid there may be about 50 parts of molybdic acid. As the ammonium molybdate of commerce contains about 83 per cent of molybdic acid, about 100 c.c. of the above solution are required for 0·1 grm. of phosphoric acid. A large excess of molybdic acid is not a direct obstacle to the exactitude of the operation, but it is a hindrance not to be desired, since a certain quantity of free molybdic acid is almost always deposited, which does not easily redissolve in ammonia. It is sufficient for the complete precipitation of the phosphoric acid to let the mixture digest for four to six hours at 50° C. After cooling, the yellow precipitate is filtered, and washed with a mixture of solution of molybdate of ammonia and water, equal parts. The yellow precipitate of phospho-molybdate of ammonia is dissolved upon the filter with dilute *hot* ammonia, 1 part of commercial ammonia to 3 of water. It is necessary to neutralise the excess of ammonia with hydrochloric acid. Chloride of ammonium is formed, an excess of which is not desirable; hence, the yellow precipitate should be dissolved in as little ammonia as possible. Hydrochloric acid is added to the ammoniacal solution as long as the precipitate formed re-dissolves quickly. The liquid must then be cooled before adding the magnesian mixture, for, if hot, basic salts of magnesia are sometimes thrown down, and increase the weight of the result. The magnesian mixture is prepared with 110 grms. of crystalline chloride of magnesium, 140 chloride of ammonium, 700 of liquid ammonia, and 1300 of water. To precipitate 0·1 grm. of phosphoric acid, we require 10 c.c. of this mixture. The presence of soluble magnesic salts diminishes the solubility of the double phosphate of magnesia and ammonia. After adding the magnesian mixture, we pour in one-third of its volume of concentrated liquid ammonia. The total bulk of the liquid should not exceed from 100 to 110 c.c. In three or four hours the precipitate is ready for filtration.

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The precipitate is washed on the filter with dilute ammonia (3 : 1) until chlorine can no longer be detected in the filtrate. No subsequent correction is needful. When dry, the precipitate is removed from the filter (which is burnt separately). The flame must be feeble at first, and be gradually increased. It is finally ignited with the gas blowpipe.

Brief Description of the Systematic Course of the Volumetric Analysis of a Superphosphate.—20 grms. of the sample are treated with water in a mortar. The lumps are broken up without pressing them strongly, and the whole poured into a litre-flask, which is filled with water up to the mark, closed with a stopper, shaken briskly for some minutes, and filtered immediately. This method of extraction is not applicable to superphosphates prepared from Lahn phosphorite, which must be extracted by washing on the filter (see Fresenius, Neubauer, and Luck). The filtrate is examined with acetate of sodium to find if there is a precipitate of phosphate of iron. If there is a precipitate, 200 c.c. of the filtrate are mixed with 50 c.c. of a solution containing per litre 100 grms. of crystalline acetate of soda, 100 grms. of concentrated acetic acid, equivalent to 30 or 40 grms. of glacial acid. Filter to separate the precipitate, wash on the filter three or four times in boiling water, ignite in a platinum crucible, and calculate 0·47 of the final weight as phosphoric acid. The liquid filtered from the precipitate of phosphate of iron is then titrated; 50 c.c. of this represent 40 c.c. of the original solution. If there is no precipitate of phosphate of iron, titrate 50 c.c. with uranium solution, after the additon of 10 c.c. of a mixture of acetate of soda and acetic acid. The acetate of soda and free acetic acid are not without influence upon the appearance of the final reaction of uranium with ferrocyanide of potassium. It is therefore necessary in titrating the uranium solution with phosphate of lime to add the above mixture in a quantity exactly equal to that used for superphosphates.

Titration of the Uranic Solution.——500 grms. of nitrate or acetate of uranium (crystalline) diluted with water to the bulk of 14 litres, yield a solution, of which 1 c.c. precipitates about 5 milligrms. of phosphoric acid. Nevertheless it is prudent to take an excess of 25 to 30 grms. of the uranic salt, since there remains almost invariably a deposit of insoluble basic salts. As the nitrate always contains free nitric acid we add, to neutralise it, acetate of soda in the proportion of 50 grms. to 500 grms. of the uranic salt. To the acetate we add, per 500 grms., 50 to 100 grms. of concentrated acetic acid, which renders the solution of the salt more stable. It is needful to let the uranic solution stand some days before filtering, since the deposition of the basic salt does not take place immediately. It is best to standardise, not with sodic phosphate, but with an acid calcic phosphate; thus reproducing, as far as possible, the circumstances to be dealt with in the analysis of superphosphates. To prepare the liquid for titrating the uranic salt, digest 5·5 grms. of tribasic phosphate of lime with dilute sulphuric acid, containing 2·85 to 2·90 grms. of SO_3. The authors employ for this purpose the dilute sulphuric acid serving for the determination of nitrogen by Will and Varrentrapp's method. After digestion the mass is taken up with water, and diluted to 1 litre. It is then filtered to remove sulphate of lime, and the small quantity of basic phosphate of lime which has not been dissolved. It is more convenient, and quite as exact, to dissolve the pure basic calcic phosphate in a slight excess of nitric acid, and to determine the amount of phosphoric acid contained in the liquid by adding ammonia, and igniting the precipitate. It must not be forgotten that tribasic phosphate of lime, though it appears dry, still contains 10 to 15 per cent of moisture, account of which must be taken in preparing the solution for standardising. 50 c.c. of this liquid contain about 0·125 grm. of phosphoric acid, and are precipitated by 25 c.c. of the uranic solution prepared as above directed. For the titration itself take 50 c.c. of the solution, *i.e.*, as much phosphoric as there is in the solution of a superphosphate at 12½ per cent (of which 20 grms. form 1 litre of solution); add 10 c.c. of acetate of soda, and run in the uranic liquid into the cold solution till the reaction begins to appear. Then boil, and try the reaction of ferrocyanide of potassium with a drop of the liquid upon a porcelain plate. To have the final reaction very distinct, dry pulverised ferrocyanide of potassium must be used. A quite freshly prepared solution also gives a distinct and regular reaction, but an old one does not. The solution of superphosphate is determined in the manner just described, in 50 c.c. With very rich superphosphates the final reaction loses somewhat of its distinctness, from the uranic phosphate which is abundantly precipitated. To avoid this inconvenience, take 25 c.c. in place of 50, and dilute with an equal volume of water.

Losses of Nitric Acid in the Manufacture of Sulphuric Acid.—M. W. Hasenbach.—This paper has been already noticed.

Researches on the Decomposition of Certain Salts by Water.—M. A. Ditte.—Noticed elsewhere.

Applications of Indigo.—M. A. Schultz.—Reserved for insertion in full.

Extract of Indigo.—M. P. Hubert.—It is well known that extract of indigo is sodic sulphindigotate, precipitated from a sulphuric solution of indigo by means of soda crystals and chloride of sodium. The product, after being washed more or less perfectly, often still contains a greenish matter, which is visible if a little of the extract is spread out on filter-paper. To assay a sample, two grms. are dried in a stove. The loss in weight shows the quantity of water present. The residue is ignited, and weighed to find the mineral matter. The amount of indigo is shown by the difference. According to M. Girardin, the extracts of commerce are divided into single, double, and treble, according to their strength. The following is the mean composition :—

	Water.	Indigo.	Salts.
Single extract ..	89·0	4·96	5·7
Double extract ..	85·0	10·20	4·8
Treble extract ..	73·7	12·40	13·9

The following results have been obtained with commercial samples at Rheims :—

	1.	2.	3.	4.	5.	6.
Water	84·5	89·7	82·65	91·15	88·6	87·2
Indigo	10·6	5·6	9·55	6·05	8·2	8·4
Salts	4·7	4·7	7·80	2·85	5·2	4·4

But the dyer has still to make comparative trials with a solution containing 1 grm. per litre of the sample, and with a similar solution of a standard quality. The shades must be compared in the colorimeter; two swatches of merino of equal weight must be dyed, sulphate of soda and sulphuric acid having been previously added, and a decolourisation assay must be made with a standard solution of potassic permanganate, containing 0·5 grm. of the crystalline salt per litre.

Influence of the Presence of Nitrogen in Textile Fibres on the Direct Fixation of the Aniline Colours. M. E. Jacquemin.—The author shows that gun-cotton takes up magenta in the same manner as do silk and wool. On the other hand, oxamide could not be dyed in a solution of magenta at 80°.

Liebig's Annalen der Chemie und Pharmacie.
Band 175, Heft 3, Jan. 23, 1875.

On Amidoid Derivatives of Hydroxylamin.—This paper is divided into five sections, namely:—On the Formation of Diphenyl-urea from Dibenzhydroxamic Acid, and the Transformation of Benzoic Acid into Aniline, by H. Rotermund; On the Structural Formulæ of Hydroxylamin and its Amidoid Derivatives, by W. Lossen; On the Distillation of Dihydroxamic Acids, by F. Pieschel; On the Methods of Replacing the Carboxyl-group of Aromatic Acids by the Amid-group, by W.

Lossen; and On the Ethers of Dihydroxamic Acids, by E. Eiseler. None of these essays are susceptible of useful abstraction.

Properties of Normal Sulphobutylic Acid, and its Salts.—N. Grabowsky.—The author describes the pure normal acid, $CH_3CH_2CH_2CH_2SO_2OH$, as a thick syrupy liquid, in which no trace of crystallisation appears. It is readily soluble in water and alcohol, but more sparingly in ether. It readily forms salts with carbonates and hydrated oxides. The soda salt, $C_4H_9SO_3Na$, forms tabular crystals free from crystalline water, readily soluble in water and boiling alcohol. The baryta salt, $(C_4H_9SO_3)_2Ba+H_2O$ forms large foliaceous crystals which on exposure to dry air lose their crystalline water, but without any alteration in form. The author has also produced and examined the lime, lead, copper, and silver salts.

Action of Nitric Acid upon Normal Butyl-sulphide.—N. Grabowsky.—The author obtains as the result of the reaction butyl-sulphon, $(C_4H_9)_2SO_2$. He concludes that as a general law thio-ethers with normal radicals are able to form both oxides and sulphones, but those with abnormal and mixed radicals oxides only.

Synthesis of Diethyl-Carbinol, a New Isomer of Amylic Alcohol.—G. Wagner and Alex. Saytzeff.—The authors obtained this compound by adding to a mixture of 1 molecule of formic ether and 4 molecules of iodide of ethyl a little zinc-sodium, and so much dry, finely granulated zinc that it may just rise above the surface of the liquid.

New Synthesis of Secondary Butylic Alcohol.—J. Kanownikoff and Alex. Saytzeff.—The authors obtained this compound by the reaction of 1 molecule formic ether with 1 molecule iodide of ethyl and 1 molecule iodide of methyl, with the addition of zinc and zinc-sodium, as in the former paper.

An Improved Apparatus for Fractionated Distillation.—G. Glinsky.—This paper is not intelligible without the accompanying illustration.

Composition of the Platinum Compound of Dehydro-triaceton-amin.—W. Heintz.—The author demonstrates that this body is not identical with Städeler's acetonin-platin-chloride.

MEETINGS FOR THE WEEK.

Monday, 12th.—Medical, 8
— London Institution, 5.
— Geographical, 8.30.
Tuesday 13th.—Civil Engineers, 8.
— Photographic, 8.
— Anthropological, 8.
— Royal Institution, 3. Prof. Duncan, "On the Grander Phenomena of Physical Geography."
Wednesday, 14th.—Society of Arts, 8.
— Geological, 8.
Thursday, 15th.—Royal Institution, 3. Prof. Seeley, "On the Fossil Forms of Flying Animals."
— Royal, 8.30.
— Chemical, 8. J. W. Thomas, "On the Gases Enclosed in Coal from the South Wales Basin, and Gases Evolved by Blowers, and by Boring into the Coal itself." G. H. Beckett and Dr. Wright, "On Narcotine, Cotarnine, and Hydrocotarnine." Dr. Armstrong, "Note on Isomeric Change in the Phenol Series."
— Royal Society Club, 6.30.
— London Institution, 7.
Friday, 16th.—Royal Institution 8. Weekly Evening Meeting Prof. Gladstone, "On the Progress of Science in Elementary Schools," 9.
Saturday 17th.—Royal Institution, 3. Mr. George Smith, "On the History of Assyria."

NOTES AND QUERIES.

Beer.—Would any of your readers inform me where any systematic analysis of beer (that can be relied on) is described, especially concerning the detection of the bitter principles used for adulteration?—M.B

Testing Fibres in Cloth.—Could you kindly inform us if there is any means of testing cloth made with a mixture of cows' hair, goats' hair, and wool, so as to demonstrate what quantity of each it contains, or whether there is any wool at all in it? We want to know how to tell the difference.—R. H. S.

Anthracene.—Having recently been engaged in the manufacture of anthracene, I am anxious to gain all the information on that subject I possibly can obtain. Would you kindly inform me of the best works on that particular source of manufacture, or of tar in general, and its products?—W. F.

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THE CHEMICAL NEWS.

VOL. XXXI. No. 803.

THE EXTRACTION OF SILVER FROM CUPREOUS IRON PYRITES.*

By THOMAS GIBB, F.C.S.,
Associate of the Royal School of Mines.

"CUPREOUS PYRITES," now largely imported from Spain and Portugal to supply sulphur for the manufacture of sulphuric acid, contains silver and gold in minute proportions. These metals are obtained in solution with copper in the process usually adopted for extracting that metal, and much attention has been directed towards the discovery of cheap methods of separating them from the copper solutions.

The sulphuric acid manufacturer first burns off as much sulphur from cupreous pyrites as he finds expedient, and the residues come into the hands of the metallurgist. The relative proportions of copper and silver, in residues from the chief varieties of pyrites, are as follow:—

	Copper, per cent.	Silver, per ton.
Rio Tinto	3·80	1 oz. 4 dwts.
Tharsis	3·50	15 ,,
San Domingos (Mason's)	3·70	15 ,,

The process generally adopted for extracting copper from burnt pyrites consists essentially of three chief operations, viz.:—(1) Formation of chloride of copper by calcining the burnt ores with common salt; (2) separation of this chloride from the mass by lixiviation; and (3) precipitation of copper by metallic iron from the solution so obtained.

Silver and gold are chloridised in the calcination, and dissolved with the chloride of copper—chloride of silver being dissolved in the first washings, which contain a comparatively very large proportion of metallic chlorides, besides, in most cases, chloride of sodium.

When these solutions are digested on metallic iron, the silver and gold are precipitated with the copper, and many attempts have been made to separate economically the precious metals from the solutions before precipitating the copper, or from the copper after precipitation.

At first sight the problem appears easy; comparison with Augustin's process for extracting silver from copper regulus suggests at once digestion of the solutions on metallic copper, but before anything like complete separation is accomplished the cupric chloride must be reduced to cuprous chloride, and when dealing with solutions in which the relative proportions of copper and silver are so extremely unequal (about 1600 to 1), the slowness of the reduction of cupric chloride, and the sparing solubility of cuprous chloride, render the process quite impracticable. On this principle, Claudet† proposed to employ spongy iron slightly in excess of the proportion required to change the cupric to cuprous chloride, and Wright‡ to employ metallic copper in an extremely fine state of division. But the reduction of cupric chloride, even when spongy iron is used, is not easy on the large scale, and cuprous chloride is an extremely troublesome salt to deal with in large proportions in solutions. Neither process appears to have been found practicable. Henderson and Down‖ proposed to calcine the precipitated metals, with a view to volatilise the silver as chloride and collect it in a condenser, and an attempt was made to work this process at the Alderley Edge Mine, in Cheshire. The process was abandoned, I believe, on its being found, after working a large quantity of precipitate, that no silver had been condensed.

Where precipitated copper is dissolved, after calcination, for the manufacture of sulphate of copper, the silver and gold are obtained from the residue left in the dissolving tanks. This manufacture being unimportant, the recovery of the precious metals by its means is of very limited application, but no other process was found practicable until the beginning of 1870, when a process patented by F. Claudet* was introduced by J. A. Phillips at the Widnes Metal Works.

Claudet's process depends on the almost complete insolubility of iodide of silver in cold solutions of metallic and alkaline chlorides, and is conducted as follows:—In lixiviating burnt ores after calcination with common salt, Phillips has found that the first three washings contain about 95 per cent of the soluble silver, and these washings only are run into settlers preparatory to silver precipitation; the remaining washings being treated directly for the copper they contain. After settling, the first liquors are run into precipitating tanks, a sample is taken from each tank and assayed for silver, and a quantity of iodide of potassium solution, calculated as equivalent to the silver found by assay, is added to the copper liquor. At the same time the liquor is diluted by about one-tenth its bulk of water, and mixed with some milk of lime, whilst the whole is kept continually stirred. Iodide of silver, sulphates of lead and lime, and subchloride and oxychloride of copper precipitate, and are allowed to settle during two or three days. From time to time the accumulated precipitate is removed, washed with dilute hydrochloric acid to remove the copper salts, and treated with metallic zinc, which decomposes the iodides with production of iodide of zinc and metallic silver and gold. The iodide is dissolved out, standardised, and employed instead of iodide of potassium in operating on further quantities of liquor. The composition of the residue is given by Mr. Claudet, as under:—

Silver	5·95
Gold	0·06
Lead	62·28
Copper	0·60
Oxide of zinc	15·46
Oxide of iron	1·50
Lime	1·10
Sulphuric acid	7·68
Insoluble residue	1·75
Oxygen and loss	3·62
	100·00

By the recovery of the iodine in combination with zinc, the cost for iodide is reduced to that required to keep up the loss in carrying on the operations, and is only a small proportion of the value of the precious metals recovered. This process has been very profitable in the hands of Mr. Phillips, who has succeeded in recovering about two-thirds of the silver, and probably a larger proportion of the gold in the ores worked in the Widnes Metal Works, since its introduction.

Other extractors have been less successful in the application of Claudet's process, and in some works the process has been abandoned after a trial. One cause of want of success appears to be the presence of cuprous chloride in copper solutions. When ores, badly burnt or otherwise refractory, are calcined in hand-worked furnaces, or when a high temperature is employed in calcination, a considerable quantity of cuprous chloride is formed. The following testings of ores from different works shows the great difference in relative proportions of cupric and cuprous chlorides in calcined ores:—

* A Paper read before the Tyne Chemical Society.
† No. 1101, A.D. 1871.
‡ No. 827, A.D. 1871.
‖ No. 2525, A.D. 1860.
* No. 282, A.D. 1870.

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	Per cent.			
Cupric chloride ..	6·70	4·03	4·25	3·75
Cuprous chloride ..	Nil	0·21	0·45	0·62

When cuprous chloride is present in copper liquors in considerable quantity, it is precipitated on dilution of the liquors, when iodide is added, increasing the quantity of precipitate, to be further dealt with to obtain the argentiferous residue; and in presence of cuprous chloride, the silver is incompletely precipitated on addition of its equivalent of soluble iodide to the liquors. In the Widnes Works great care is observed to avoid the formation of cuprous chloride, and to this care the especial success of Claudet's process in these works is doubtless attributable.

A process adopted by the Bede Metal and Chemical Company, and continuously worked for a considerable time past, consists in the precipitation of the greater part of the silver, simultaneously with a comparatively small proportion of the copper, from copper liquors by sulphuretted hydrogen. On first passing this precipitant into copper liquors, a much larger proportion of the total silver than of the total copper in solution is precipitated. The first series of experiments, in which sulphuretted hydrogen produced by the ordinary laboratory method was employed, led to the expectation that with 10 per cent of the copper 70 per cent of the silver would be precipitated. But when H_2S, much diluted, was blown through the liquors, producing a violent agitation, a much more perfect concentration of the silver was obtained. In practice, H_2S is obtained by the action of dilute hydrochloric acid on "tank waste." The tank waste is placed in covered tanks of wood, 6 feet square and deep inside, on a bed of ashes over a false bottom of narrow boards. The acid is conducted under the false bottom, and rises through the waste to an overflow pipe, 2 feet 6 inches from the top, thus giving a large space for frothing, &c.

The sulphuretted hydrogen evolved in mixture with carbonic acid is drawn off by a blowing engine, and blown with a large quantity of air, purposely drawn in for dilution, through the copper liquors. Before blowing, a sample is taken from each tank and tested for copper, by standard cyanide of potassium solution. The blowing is allowed to go on—usually for about twenty minutes—until a sample of the liquor gives 6 per cent less copper than the first sample. All the liquor produced in lixiviating the ores is treated by this method, and boys, testing without analytical training, are able, with the aid of a table, to come very near the precipitation of any percentage of copper that may have been decided on. The precipitate is allowed to settle, and the liquors are drawn off to the copper precipitating tanks. The precipitate is run off into washing tanks, where as much of the copper solution is removed as is practicable, and the precipitate is at last collected in a filter on the Needham and Kite plan, but with chambers of more than twenty times the usual capacity.

The following are the average testings of the liquors and precipitate:—

	Copper, per Litre.	Silver, per Ton of Copper.	
	Grms.	Ozs.	Dwts.
Original solutions ..	20·1	18	0
Desilverised solutions..	18·8	2	19
Precipitated by H_2S ..	1·3	220	0

The washed argentiferous sulphide is not quite free from chlorides, and in the next operation, viz., calcination at a low temperature, silver and copper are pro- duced. The calcined mass is ground and lixiviated, first with water to dissolve chloride of copper with a little free acid, then with hot solution of carbonate of soda to dissolve chloride of silver. The residue contains some sulphate of lead, some sulphide of lime and oxide of copper, and is practically free from chlorine. It is digested in dilute sulphuric acid to separate the oxide of copper, and again washed. After drying, the residue has the following composition:—

Silver	8 77
Oxide of lead..	28·66
Oxide of copper	3·75
Peroxide of iron	2·61
Lime	13·67
Sulphuric acid	31·72
Chlorine	4·70
Water	4·20
Insoluble residue..	1·40
	99·48

The method described of separating the silver from the precipitated sulphide of copper is somewhat complicated, but it has been adopted, after several modifications, as the most economical. The quantity of material to be treated in the latter operations being comparatively small, requires very few men, and otherwise is not expensive.

The proportion of silver recoverable from burnt ore—about 1 part from 60,000—although extremely minute, yet amounts in value in Tharsis and Mason's ores to 2s. 6d. per ton, whilst the cost of extraction, by either Claudet's process or the process last described, is about 10d. per ton of ore worked; and when it is considered that 350,000 tons of such residues are produced annually, the aggregate value of the precious metals recoverable by these processes cannot be regarded as unimportant.

ON THE WIDE DIFFUSION OF VANADIUM AND ITS ASSOCIATION WITH PHOSPHORUS IN MANY ROCKS.*

By A. A. HAYES, M.D.

Christian Keferstein, as early as 1834, had boldly stated the proposition that "all crystalline non-stratified rocks, from granite to lava, are products of the transformation of sedimentary strata," and later researches aid in confirming the truthfulness of this view.

Simply considered, all rocks consist of a basis material, generally simple minerals, such as compound silicates, aluminates, or even quartz, in various states of division, united by a compound which acts the part of a cement, which through its composition is more easily acted on by ordinary agents than the particles of the mineral it unites.

This part of every rock engages attention, also, from its acting as a positive compound does in a simple mineral. It is complex in composition; usually it consists of silicates of protoxide basis. At one moment of time it binds the particles with great force; at another, under altered conditions, it relaxes its bonds, itself losing cohesion, crumbling and becoming an earth containing the elements necessary to vegetation, while the bonded materials drop to their condition before union.

Accepting Keferstein's expression in its fullest sense, I have applied the resources of analysis to a large number of rock aggregates, and the results of my experiments have shown the interest and extent of this field of inquiry. To do this, I have departed from the ordinary course of analysis, and applied a principle which, many years since, enabled me accurately to separate alkalies from mineral compounds. This principle is the adaptation of a definite mixture of agents, so that while one part of the mixture is searching for and dissolving the substance to be studied, the other part is holding in a semi-fluid state the larger part of the substance and allowing any reactions or adjustments of composition to take place. The subsequent solution and boiling determines the precipitation of

* From the *Proceedings of the American Academy*, Presented January 12 1875.

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compounds not soluble in the medium. This medium is subsequently decomposed and products divided.

Mode of Analysis.

The rock perfectly cleansed by washing and brushing, reduced to fine powder, is either dried for its combined water or taken in its natural state. A flux is prepared by melting 202 parts of potassic nitrate with 53 parts of sodic carbonate, both pure. The cooled mass, reduced to powder, absorbs about 0·004 part when exposed to the air, and must be kept in a closed bottle. This *basis* flux can be adapted to meet all cases of varied composition in minerals. 1 grm. of the rock or mineral is mixed intimately with 1·28 grms. or 2 grms. of this flux in a tall, narrow crucible of platinum, on which no action is exerted. The crucible, covered, is heated over an ordinary Bunsen table lamp, gently while intumescence continues; the heat increased, hissing ceases, a slow sintering follows, and in 12 to 20 minutes the action is over, about one-half the whole power of the lamp being used.

The fused mass, mostly removed from the crucible by a looped platinum wire, with the crucible and cover, are boiled in water. The basic silicates, more or less altered, remain; the soluble compounds dissolve, and the filtered solutions and washings, making 40 to 50 c.c., are evaporated in a platinum basin to about 6 c.c. To the hot solution, ammonic chloride, a little in excess of the equivalent of sodic carbonate used, is added, from a titrated pure solution, the basin put on a water-bath, the contents evaporated, and carefully dried at a temperature not exceeding 100° C. After the addition of the ammonic chloride, the silicic acid gelatinises, and, in drying, passes out of combination with the alkalies. By subsequent boiling in water and filtration, the precipitated silicic compounds are obtained.

The filtrate and washings contain other combinations, which can be treated either in the normal state of acid ammonic salts, or after the addition of a drop of ammonic hydrate renders the solution neutral to test-paper. Numerous cases occur, rendering modifications necessary. Chlorine, bromine, iodine, sulphur, compel a choice of ammonic salts. Many of the acid-forming metals are separated by their characteristic reactions, from the residue of fusion. In general, if the solution of the result of fusion does not deposit silicic acid on the addition of an ammonic salt, 0·25 grm. of silicic acid, with or without its equivalent of sodic carbonate, is added; because the displacement of other acids depends on the presence of an excess of silicic acid. The solution containing nitrites is delicately balanced, but it is always adapted to the statical determination of phosphoric acid by the magnesia mixture, or its estimation volumetrically, in using uranic nitrate. The quantity of phosphoric acid present in mineral or artificial forms of compounds can thus be accurately obtained, and the most compact aggregates do not resist solution.

Wide Distribution of Phosphorus.

In applying this mode of analysis to a great variety of rocks, it soon became evident that phosphoric acid is widely distributed. In some cases, the basis, as well as the cementing part, of a rock contained it, so that adherence to the plan of seeking it in classified rocks was not possible. Associated with silicates of the more basic earths and the protoxides of metals, it is found in all the clays, the new and old lavas, trachytes, slates,—from the most fissile to the most compact—shales, ashes of coals; in the rocks formed of quartz, felspar, and mica; in aggregates where felspar is replaced by quartzite, and in those containing chlorite. The well-known conglomerates of Roxbury, and a siliceous slate reposing near it, contain phosphates.

In the opaque felspars, the ancient porphyries of Rome and Carthage, phosphates occur; but the glassy and rose-coloured varieties have not afforded it. The lepidolite of Paris, Me., contains it; furnace products, slags from copper and zinc, afford it. This list might be extended, without indicating to any law relating to the affinities, which may perhaps be discovered as the observations are multiplied. We have in phosphatic salts in rocks another consolidating material, and an element of change.

Vanadium Associated with Phosphorus.

In many of the analyses made after the method described, another acid was found associated with phosphoric acid, and this was easily proved to be a compound of *vanadium*. The frequency of its occurrence as acid or oxide, its well-marked characters as a changeful body, the colours of its compounds and mixtures, give great interest to this discovery. Owing to its association with proto-salts of manganese and iron in rocks, it proves to be active, first as a binding, and secondly as a disintegrating, agent. It is a matter of surprise that the dissemination of vanadium has not before been noted, especially since its later classification with phosphorus leads to such a conclusion.

When the rocks treated by the above method for phosphoric acid contain manganic compounds, if the second filtrate, balanced by ammonic salts, has any yellow tint, vanadic acid salts are almost surely present. It occurs with phosphoric acid in most of the mineral bodies named above. The physical character of colour of the rock is the only indication I now know. The green and plum colours of slates and porphyries; the greenish epidote colour of many aggregates; the changed colours, seen in sandstones, and especially in roofing slates, from world-wide localities, are guiding marks merely. My observations have been quite numerous, and as yet no proper *ore* of vanadium has been found, but sources of economical separation have been suggested.

As vanadium occurs in many well-trodden paths, I deemed it important to devise a direct way of obtaining it, in which no metal and the fewest reagents are employed.

Process.

Crush in the diamond mortar 1 to 1½ grms. of greenish slate to a fine and coarse powder; place in a watch crystal, and wet thoroughly with a solution of one-fourth sulphuric hydrate, leaving a little excess. Expose freely to dry, warm air—sunshine, if possible; and, if the slate is acted on, after 2 to 4 days, when the mass is nearly dry, the salts formed crystallise. Under a lens, a number of green or bluish-black spherical crystalline aggregates, unlike any other matter present, will be seen. These are a double salt, in which blue oxide of vanadium exists; and from such a small weight, often, enough crystals can be picked out for showing the characters of vanadium compounds. It is best to use several differing specimens, which by their colours indicate proto-silicates, and to be sure that they have been carefully washed, as granites are often invested with a lichen of a hemispherical form. One is often surprised to see the number of these crystals extruded from the mass of salt, and formed under constraint. The oxidised rocks do not afford these crystals, but we see bands of yellow vanadium compounds, denoting the condition of the substance.

The ordinary tests of vanadium are best applied to the vanadates, and among them the gall test is delicate and discriminating. If the greenish-black precipitate it forms in acid solutions be burned, the insoluble oxide obtained (when the precipitate is entirely free from any chloride) has characteristic reactions with acids, and in the blow-pipe flame with fluxes. The salts of vanadium in mixture with manganous salts, precipitated by excess of ammonic hydrate, afford a blue solution above the oxides, rivalling that of cupric oxide.

By oxidising the blackish-blue salt obtained by sulphuric hydrate, the yellow compounds form, and may be tested under both modifications.

The vanadate of ammonia present in the balanced solution from the silicates, by the mode of analysis described above, may be separated by over-saturating the solution

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with ammonic chloride, when ammonic vanadate separates, although phosphoric acid is present. From the vanadate other combinations of vanadium may be formed. The solution does not then respond to the gall tests; and the ammonic vanadate separated, when heated, leaves vanadic acid. The deposit caused by tinct. galls may be calcined for VO^4. In testing for phosphoric acid, in this mixed solution, the magnesia mixture does not respond at once, unless the device of Wollaston be used; and, in strong solutions, plumose vanadates form. If heat is applied to the salts in mixture with chlorides, much of the vanadium will be lost. In most of the rocks containing phosphorus, vanadium has been found associated. Manganese is also a congener; and without repeating here the list of rocks, I can promise in a future paper to give a tabulated series.

In Utah, in the Tinctic District, there is a chalcedonic rock, with brown ferric and cupric ore. In the brown part of this ore both phosphorus and vanadium are abundant. The presence of vanadium, in crusts on copper rock of Lake Superior, announced some years since, by my late friend, J. E. Teschemacher, has been lately confirmed. It is present in light greyish earth-like substance of the datholite beds in the Calumet and Hecla mines. At present it appears that vanadium is as common a constituent of rocks as manganese.

Vanadic Compounds in Water.

The beautiful suburb of Boston, Brooklin, owes its varied surface and scenic effect largely to *water action* in forming the gravel drift into elevations and depressions, having curved and graceful lines. This drift presents us with a magazine of rock aggregates, which not only supply the laboratory, but, in various cuttings, allow us to watch the influence of air, frost, and water on the rocks; which, stable in their beds, become changed, even rapidly, on exposure to these agencies. This gravel, permeated by air, changing under every variation of pressure, is powerfully oxidising; and the rain water, even if coloured on entering it, becomes colourless and sparkling at 8 yards below the surface. The gravel contains strata and inclined dykes of extremely finely divided micaceous earth, or "quicksand," in which the water circulates and passes to the ocean at different levels. An *average* result of partial analyses is:—1 litre affords by evaporation and drying at 100° 0·350 grm., of this amount 0·182 grm. is nearly insoluble matter; 0·168 grm. again dissolves in water, and contains, besides the ordinary salts, soluble silicates, not altered by boiling, drying, or heat of 100° C. These waters attack crystal glass, leaving an incrustation, which resists weak acids; and they seem to be free to act in re-consolidating strata. Indeed, in the deep parts of the gravel deposits, we meet with masses of rock in which solution of the silicates in water is hourly going on; and we may follow these solutions to the wells, and observe that sometimes depositions are formed on the surfaces of the rocks, over which they pass.

Vanadium exists in the water which supplies the wells of the district of the drift as a transparent, colourless solution of magnesian calcic, manganous, and ferrous silicates, phosphates, carbonates, and vanadates.

The deposit which forms in the boiling water resembles in composition the matter as taken from rocks by weak solvents, although some of these compounds remain dissolved in the water after it has been boiled.

Detection of vanadium as oxide is easily and at once effected, by dissolving the deposit formed from boiling water, by means of diluted nitric or sulphuric hydrate. In this solution, the addition of a slight excess of ammonic hydrate, and a [illegible] siderable excess of ammonic [illegible] n of any vanadic [illegible] ous oxides, and [illegible] nesic oxide and [illegible] solution of a [illegible] strip [illegible] plu-tion, at first as a thin bronze coating, then after a black crust.

I believe this is the first discovery of vanadic compounds in water. Before announcing it, every source of error has been scanned; and the labour of connecting the compounds with the rocks where they originate has been performed, as necessary to completeness, in the evidence.

Manganous salts have been observed in waters where humic acid has acted on rocks containing manganous carbonate, and the existence of a water of this kind is known to me; but it must be considered quite apart in composition from a water in which soluble silicates include manganous silicate as part of a compound possessing novel characters.

In concluding this brief account of results proving the existence of phosphates and vanadic compounds in the cementing material of the most common rocks, I wish it to be considered as only introductory to a wide field of interesting research.

THE TREATMENT OF COPPER ORES.

At a meeting of the Great Snowdon Mountain Copper Mining Company, held at the London Tavern on the 24th March, 1875, Mr. J. P. Wilkes (of Messrs. Wilkes Brothers, Trinity Square, Tower Hill, E.C.), made the following remarks:—

Mr. Chairman and Gentlemen,—As requested, we have much pleasure in giving some particulars of the process for the extraction of copper from its ores, in which we are interested, and which we have already explained to some of the Directors of the Company.

The process is a chemical one, but is not a mere chemical theory, for it contains nothing but well known reactions, which can be vouched for by every chemist.

It was devised by an eminent mineralogical chemist, of very extensive and practical experience, who was consulted by a well-known Italian banking-house, with reference to some copper mines in the Alps, formerly the property of the late Count Cavour. He was desired, if possible, to discover some cheap method of extracting the copper from the ores with which the property abounded, but which were so poor in copper, that he was informed that he could have no materials to work with but what he could find upon the mountain, or were contained in the ores themselves; they would not otherwise pay for treatment.

The ores were very similar to those of the Snowdon Mines, the bulk of which, as indeed is the case with by far the greater portion of the sulphuretted copper ores found in the United Kingdom, are too poor to be profitably dressed by water, owing to the extraordinary waste that accompanies all water processes, and the impossibility of extracting the whole of the copper by that method. His investigations, which were patiently continued for a considerable period, resulted in the erection of trial works; the various steps of the process were tested in every way, and having been practicaly demonstrated to be correct, and *commercially successful*, the bankers referred to are now expending upwards of £10,000 in the erection of extensive works to carry on their operations; and the process is now protected by patent in the United Kingdom, and the chief copper-producing countries of the world.

Two of the leading objects of the process are—(1) The conversion of the copper into a state of solution; and (2) the extraction or precipitation of the copper from that solution. The residues of the cupreous pyrites now so largely imported into England from Spain and other countries, and which are comparatively concentrated by the elimination of the sulphur originally contained in the ores, are generally chlorodised or roasted with chloride of sodium (common salt) in order to render the copper they

contain soluble, and the copper is then precipitated from the solution by means of iron, which is sacrificed in the process; but chloridisation, as now performed, is too imperfect and wasteful, and the precipitation of copper by iron is far too costly to admit of the profitable treatment of low-class ores by such methods. In our process, those ores which contain sufficient sulphur to support combustion are first employed to roast themselves; but as we at present consider that the bulk of the Snowdon ores will be better treated by the second method of our process, it will not be necessary to explain the particulars of the treatment which applies best to ores of that class. The Snowdon ores would be first crushed, and mixed with a small quantity of burnt lime, and made up into any convenient shape for stacking as an ordinary brick-kiln would be stacked, or built, for burning; the mass or kiln of ore would then be burnt at a low red heat for a short time, which would require but little fuel to accomplish, and the roasted ores would then be crushed, and tipped into conveniently placed tanks or vats, containing, when the process is started for the first time, water, but which, after repeated use, will become a highly concentrated acid liquor, containing a large proportion of sulphuric acid, resulting from the burning of the ores with lime.

By the roasting of the ores in this manner with lime, the whole of the copper they contain will become converted from its original form of a sulphide or sulphuret into a soluble sulphate of copper, a chemical combination of copper with sulphuric acid; and for the information of our chemical hearers, we may mention that any small portion of copper sulphide which may have become converted into a simple oxide by inattention in roasting, will be easily dissolved out into soluble sulphate of copper in the strong acid liquor we have formed, as already stated, by our repeated washings of the various batches of roasted ore.

We have now to extract the copper from the solution; we therefore draw off the liquor into other tanks, or vats, and pass in sulphuretted hydrogen gas, which we can produce by another part of our process in any desired quantity from the material supplied by the mine itself, at a most nominal cost. Upon the introduction of the sulphuretted hydrogen into the copper solution, the copper, having greater affinity for the sulphur, instantly combines with it, and is precipitated to the bottom of the tank as a highly concentrated and pure sulphide, containing 50 per cent and upwards of copper; the hydrogen unites with oxygen and forms water, and we liberate large quantities of sulphuric acid, and thus indirectly manufacture a most powerful solvent, the free use of which is of great benefit in our already simple and economical process. The copper precipitate, unlike the unfortunate ores containing only 4 and 6 per cent, commands its full price in the market, according to the copper standard, and may be at once either smelted, or converted into valuable salts of copper on the spot, or sold as it is.

The quantity of lime required will depend upon the amount of sulphur which has to be absorbed from the ores; for the Snowdon ores it will probably average about 5 per cent of lime to the ton of ore; and our sulphuretted hydrogen, being made from the ores themselves, it will be seen that our operations possess the elements of simplicity and economy, while it may be mentioned that we shall, in addition, easily obtain a by-product, formed during the treatment, which will go far towards covering our entire cost. We have in this process a most simple and economical method of extracting copper, and the treatment of copper ores will henceforth be reduced to a mere mathematical question.

For the treatment of the Snowdon ores under this part of the process, which we call "The Lime Process," we require the following simple plant.—

Kilns, for burning lime.

Ordinary brickmaker's pug-mills, and moulds, for shaping the prepared ore into any convenient form for stacking.

A furnace and boiler, for the production of sulphuretted hydrogen.

Vats or tanks for precipitation, sheds, tools, &c., and—

An ordinary stone-breaker and crushers, which are equally indispensable for the water process as for this.

The commercial results of the treatment of the Snowdon class of ore by the process will be best exemplified by saying, that an ore yielding the extremely low percentage of only 2 per cent of copper, will (after allowing the most ample margin for mining, and getting of say 10s. per ton of ore) result in a net profit of 30 per cent and upwards, calculated upon the average standard of the copper market, while any additional richness in the ore treated will practically be almost all clear gain. The cost of the treatment of ordinary low-class copper ores after mining, by our process, may be taken to average from 10s. to 15s. per ton of ore, according to circumstances.

With reference to the application of the process to the Snowdon Mines, we think that a sum of about £3000, which will allow a moderate working capital, will be sufficient to treat 30 tons of ore per day, the capacity, we understand, of the stone breaker, and crushers already in working order on the mines, and provide for the necessary contingent expenses; and we think it would be desirable for the Company to turn their more immediate attention to the Halvans, which, being already mined and available for use, will yield the above rate of profit, even supposing they only give a result of 1½ per cent of copper; for it must not be forgotten, that in view of this process, there is, at that percentage of copper, a considerable value in them, which may be immediately realised.

The erection of the necessary works will take but little time, and immediately upon their completion, the Snowdon Mines, with attention and economy, may realise large profits, sufficient to satisfy the most sanguine shareholder, if the Company is placed upon a sound basis, and its capital reduced; while, owing to the extensive character of the mines, these profits may be still further increased, according to the amount of capital invested in the erection of additional works.

We think it may be safely assumed that, with the appliances already upon the mines, and the working capital now asked for, and, as before said, good and careful management, the treatment of 30 tons per day of ore (yielding about 2 per cent), or of Halvans (yielding about 1½ per cent of copper), would result in a net profit of about £60 per week, or about £3000 per annum; and if we can arrange to work for a day of twenty-four, instead of ten or twelve hours, as could no doubt be done, this amount of profit would be doubled; while it must still be borne in mind that, with additional plant, 100 tons per day can be treated as successfully as 30 tons.

We are now making the necessary arrangements for the application of the process on a large scale, in the working of some extensive copper mines in this country, in which we are interested, knowing, that in this age of criticism, we shall accomplish more to secure the adoption of the process throughout the kingdom, by practically demonstrating its truths and success ourselves, and then court the investigation of the mining and chemical interests, than by all the theoretical proof and argument we could bring to bear upon the subject; and until this was accomplished, it was not our intention to bring the process into public notice; actuated, however, by a sincere wish to aid our fellow shareholders in the Great Snowdon Company in their difficulties, we have willingly done so, and trust that it is not too late for the existing Company to apply it to their mines.

We sincerely hope that the property, and the opportunity of more than retrieving all its ill fortune will not be lost; for though at the eleventh hour, we think it is not too late for the mines to realise the prosperity, and the shareholders the benefits, they deserve, assuming, of course, that the opinions of Professor Etheridge and others, as expressed in their reports, be correct.

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OBSERVATIONS ON THE "COMBUSTION-POINT."

By A. MITSCHERLICH.

By this term, he denotes the temperature at which the combustion of the body in oxygen becomes visible. Melting- and boiling-points have been carefully noted. It is strange that the combustion-point and the temperatures at which the mutual reaction of bodies takes place and decompositions ensue have been so little regarded. The observations for determining the combustion-point are not unattended with difficulties. In many bodies combustion begins slowly, and increases gradually until the point of ignition is reached, when all oxygen is generally taken up, attended with fire. In some bodies, the combustion- and ignition-points approximate, or even coincide.

From the experiments undertaken, the following conclusions may be drawn :—

(1). Every combustible simple body, or every combustible compound, whose point of decomposition lies below its point of combustion, admits of the determination of the latter.

(2). When the circumstances are the same the point of combustion is the same, and in solid bodies it is independent of the state of division.

(3). The same simple bodies have different combustion-points for different modifications, if the latter are not changed by the elevated temperature.

(4). Different modifications of the same atomic composition may have different points of combustion.

(5). If bodies enter into combination the combustion-point alters.

(6). In certain series of organic bodies the combustion-point sinks as the carbon and hydrogen increase, which in organic bodies is easily recognised by the increase of carbonic acid and water.

(7). The combustion-point in organic compounds will throw a light upon loosely- or stably-combined groups of atoms, since in general only a part of the hydrogen and carbon burn while other compounds are separated. This points out a new method for obtaining known and unknown compounds.

(8). If the combustion-points of the several organic compounds in a mixture are known, by keeping to the lowest of these it will be possible to determine their respective proportions by means of the amounts of carbonic acid and of water produced. The constituents of woods and similar mixtures can also be ascertained.—*Ber. d. Deutsch. Chem. Gesellschaft zu Berlin.*

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

April 10th, 1875.

Professor G. C. Foster, Vice-President, in the Chair.

Dr. Odling, F.R.S., was balloted for and elected a Member of the Society.

Professor H. M'Leod communicated to the Society "*Some Observations on the Defects of the Human Eye, as regards Achromatism.*" The eye has been considered to be achromatic because it practically is so, but it is easy to offer abundant evidence of the defects of the organ in this respect. For instance, to short sighted persons the moon appears to have a blue fringe; in using the spectroscope, the red and blue ends of the spectrum cannot be seen with equal distinctness without adjusting the focussing glass; a black patch of paper on a blue ground appears to have a fringed edge if viewed from even a short distance; while a black patch on a red ground, when observed under similar conditions, has a perfectly distinct margin. Professor M'Leod then explained that the overlapping of images in the eye produces the mental impression that there is no want of achromatism. It is interesting to note that Wollaston considered that the coloured bands of the spectrum were really divided by the black (Fraünhofer) lines, and his statement that the red end of the spectrum does not appear to have a boundary line, "because the eye is not competent to converge the red rays properly," shows that he had very nearly, if not quite, discovered the achromatic defects of the eye. Dr. Young ascribes to Wollaston the merit of having observed that, when a luminous point is viewed through a prism, the blue end appears to be wider than the red, the eye being incapable of recognising that the spectrum has the same width throughout its entire length. An excellent experiment was then exhibited, to show the relative distinctness of a dark line on grounds of various colours. A string, or wire, was so arranged that its shadow traversed the entire length of the spectrum, which was thrown on a screen by an electric lamp. When viewed from a short distance the edges of the shadow appeared to be sharp at the red end, but gradually became less distinct, until at the blue end nothing but a blurred line remained.

Dr. W. H. Stone considered that the paper was specially valuable, as suggesting a possible mode of investigating the relation between the defects of the eye and the personal coefficient of error in observation.

Professor Guthrie showed a kaleidoscope, devised by Mr. R. Cowper, in which the usual geometrical effects were produced by fragments of mica illuminated by polarised light.

Mr. Wilson, Demonstrator in the Physical Laboratory, South Kensington, exhibited a modification of Thomson's galvanometer, which might be readily constructed at a small expense. He used two discs of glass, and replaced the usual brass quadrants by tin-foil; the connections between the binding-screws and the quadrants were effected by fusible solder and platinum wires.

The Vice-President then alluded to the lamented death of Mr. C. Becker, of the firm of Messrs. Elliot, whose loss will be severely felt in every laboratory in this country.

SOCIETY OF PUBLIC ANALYSTS.

As the subject of the purity and the price of the gas supplied to the public by the different companies is becoming a matter of increasing interest and importance, the Bill now before Parliament is deserving of general attention; and in view of the probability of the appointment of "gas examiners" becoming general (for which appointments public analysts are in many cases the best qualified persons), it may not be inopportune to lay before our readers an outline of the Act in question, and a few comments on some of its chief provisions. The Act is described as one for regulating the metropolitan gas companies, and has been introduced by the Corporation and the Metropolitan Board of Works. The object of the Bill is twofold: first, to remedy the defects which experience has shown exist in the City of London Gas Act, 1868; and secondly, to bring all the metropolitan companies under as nearly as possible uniform regulations. We wish we could congratulate the two authorities responsible for the Bill on their new attempt at legislation, but truth compels us to express the opinion that a more crude and unworkable Bill has seldom been presented to the House of Commons. How far it can be modified in Committee (if it should ever reach that stage), so as to be a useful measure, remains to be seen, but we much doubt if those local authorities, who have taken the trouble to act on the powers given them by the Act of 1860, will care to be brought under the more cumbrous and expensive system

of the present Bill. We had hoped that, when so comprehensive an act as the present was proposed, it would have begun by making a clean sweep of all the older acts, and have contained within itself all necessary enactments. Instead of this it begins by repealing for all the metropolitan companies just those clauses of the Act of 1860 which were repealed for the City alone in the Act of 1868. The Act of 1868 is nominally repealed, but is reproduced with but few alterations, almost *verbatim*, some of the alterations being altogether inconsistent with parts of the Bill which are left untouched.

One of the evils which experience has shown to exist under the Act of 1868 was this, that, whenever through any circumstances a gas company could not pay a dividend of 10 per cent, they could call on the Board of Trade to appoint commissioners to revise the price to be charged for gas, so as to give the shareholders their 10 per cent dividend, thus relieving the company of all the chances of trade, and insuring them a regular 10 per cent at the expense of the public.

The attempt to remedy this defect is one of the most curious we ever remember; for while enacting that, under no circumstances shall a company pay more than a 10 per cent dividend, the Bill goes on to provide that, if a gas company charge more than 3s. 9d. per 1000 cubic feet, "for every penny or part of a penny charged in excess of such price, the dividend shall be reduced by 5s. per cent per annum."

Is it possible that the Metropolitan Board are not aware that this scheme has been proposed before, and rejected at once by the House as too monstrously unfair to be listened to? It is virtually saying to the companies, if things are dear, you shall bear the burden; if they are cheap, we will have the benefit! What inducement have the companies to exert themselves to make gas for less than 3s. 9d., if the whole benefit of their exertions is to go to benefit their customers? We venture to say that the public would have a much better chance of cheap gas, if it were made a matter of give and take; decrease the dividend if the companies increase the price of gas by all means, but if they lower it, let them increase their dividends in the same proportion. The public are surely better off with gas at 3s. 5d., though the company gets 11 per cent, than they are with gas at 3s. 9d., though the company only gets 10 per cent. We have every reason for thinking that a sliding scale of dividend, both upwards and downwards, would be equally acceptable to the companies and the public, and it is much to be regretted that the opportunity of thus making the interests of the companies and the public identical, instead of antagonistic, should have been lost. Turning now to that part of the Act, more strictly of a chemical nature, namely, the provisions for insuring a proper illuminating power and purity, we find all the cumbrous machinery of Gas Referees, Chief Gas Examiners, &c., of 1868, reproduced, but without the same excuse for their existence.

First, as to illuminating power, the common gas of all the companies is to be 16-candle, and is to be maintained at that power the whole twenty-four hours, the burner employed in testing being the much-abused London argand, a sample of which is to be deposited with the Warden of the Standards.

This is very well, and if the gas can be tested at some place in the midst of the district where it is consumed, at any time in the day, and the companies fined if it ever be found below the standard, the desired end would be secured; but, as though to do away with the possibility of securing what is required, the Bill goes on to provide that the Gas Referees shall prescribe, not only the mode of testing, but the times of testing, and also that the company may always have an officer present if they wish it, thus insuring that the companies shall always know the exact time at which the testing is to take place, and be prepared for it. After thus handing over the arrangement to the Gas Referees, the Act proceeds to a certain extent to tie their hands, by copying a provision of the Act of 1868, that there shall not be less than three tests made each day; this provision having its origin in the fact that the mean of all tests taken was to be regarded as the illuminating power for the day, and being absolutely valueless when no average is to be taken. As long as the candle is to be taken as the standard of comparison and the burner is prescribed, it is very difficult to see what is really left to the Referees under these clauses. But this is not all. In calculating the penalties for deficiency of illuminating power, the words of the Act of 1868 are strictly followed, viz., at so much per 100,000 feet on all gas made at the station from which the testing-house when the deficiency is discovered is supplied. Can anything be more monstrous? When an average of all tests was taken, and the testing made near the works, this was as good a mode as could be devised; but when the gas is tested where it is consumed, so that gas from various manufacturing stations may be mixed, and where any deficiency during the day subjects the company to a fine, to calculate that fine on the supposition that all gas made that day is equally deficient is, to say the least of it, a startling proposition.

As respects purity, the whole question is left open to be decided by the Referees from time to time. We had hoped that enough was now known on the subject to have ensured that these gentlemen should at least have had some minimum of purity laid down in the Act, beyond which they could not permit the companies to go.

We think we have said enough to give our readers a general idea of the proposed Bill. Much of a like kind might be added, but our readers can judge for themselves of the sort of Bill proposed, and the likelihood of good arising from it, by the specimens we have given.

NOTICES OF BOOKS.

Facts about Bread-stuffs; Illustrated with Extracts from the best Authorities. By B. Glasgow; Porteous, Brothers. London: Simpkin, Marshall, and Co.

The writer of this pamphlet, in his "Introductory Note," seems to endorse the view that the present law concerning adulteration has been "harassing and embarrassing" to trade. "There have been" says he, "many prosecutions under the Act which have resulted in individual hardships, and these are much to be regretted." We cannot agree with him. Hardships to persons who sell water as milk, chicory as coffee, and magnetic iron ore as tea, we no more regret than we do the "individual hardships" which the law occasions to coiners, forgers, burglars, &c. The adulterating tradesman is simply a habitual criminal, and hitherto he has been treated far too leniently. We are sorry to find "B" quoting as a high authority, the report of the recent Parliamentary Committee on the Adulteration of Food Act. In that document truths and errors are mingled in a very dangerous manner.

From the author's concluding sentence we are likewise compelled to dissent. "However good an Act of Parliament may be for the purpose of putting down adulteration, it is more probable that it will be extinguished by the good sense and intelligence of an enlightened people who may be educated to prove all things for themselves." We do not see that adulteration can be left to be dealt with by the unaided good sense and intelligence of the people any more than can other crimes. Is the individual consumer to send portions of every article of food and drink he buys for analysis, or worse still, to analyse them himself? Is he to repeat this process till he finds a set of tradesmen who are honest? Is he then to make public the information he has gained, at the risk of having to defend endless actions for libel? Or is he to keep silent, and allow others to come to the same knowledge by the same slow and costly process? We admit that some frauds might be quickly extirpated if the public were

wiser. If people always bought their coffee in the berry, they could not be dosed with chicory. If they refused to purchase an article retail, at a figure below its price, in the wholesale market, many vile mixtures would be driven out of use. But we may give a fair price for milk, and yet find it copiously watered; or for sherry, and yet learn, to our cost, that it contains sulphate of potash and grain-spirits.

For the rest, the author gives a fair and intelligible description of the principal bread-stuffs and their applications.

A Handbook of Hydrometry. By James Bodely Keene. London: Pitman.

An account of the construction, graduation, and use of hydrometers, with especial reference to alcoholic liquids. The author remarks in his introduction, "there are thousands who use hydrometers without the slightest mental glimpse of the principles of their construction, and to whom, in fact, they are like fetishes or talismans acting mysteriously." This is too true. We remember meeting with a practical man in the paper trade who insisted that the strength of his solutions of caustic alkali and chloride of lime could not be determined except by Baumé's instrument. We have known dyers and printers who hold that "Twaddell" must be an infallible and all sufficient guide in selecting samples of mordants, extracts of dye-woods, &c. We perceive that Mr. Keene thinks that the hydrometer should be in every house for the purpose of testing the purity of milk. This service, unfortunately, it cannot render. If we remove the cream from a sample of milk, the specific gravity rises. If we then add water, we may bring it back to its original standard. Thus the genuine article, and that which has been doubly sophisticated may give the same indications.

The author proposes a modification of Sikes's hydrometer, which appears well adapted for taking the specific gravity of non-corrosive liquids.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, March 8 and 15, 1875.

Fourth Memoir on Electro-Capillary Actions, and on the Intensity of the Forces by which they are Caused.—M. Becquerel.—The following are among the effects obtained:—The formation of fluorides of calcium in tubercular crystals on the face of a slit with a solution of chloride of calcium, separated by the slit from a solution of fluoride of ammonium. On acting with the monosulphide of sodium and nitric acid, the oxygen, which has a great affinity for the elements of the monosulphide, combines, on the one hand with the sulphur, and on the other with the sodium, whilst hyponitric acid is set free.

Alloys of Platinum and Iron.—M. H. Sainte-Claire Deville.—On analysing platin-iridium, by a method which will soon be made public, iron and platinum are united in the state of oxides intimately mixed. If this matter is treated with a current of hydrogen, oxide of iridium is reduced at common temperatures, and the iron at temperatures from 200° to 600°. The metals are then alloyed, for if digested with hydrochloric acid, a few bubbles only of hydrogen escape, and very little iron is dissolved, even when it exists in the alloy to the extent of 10 per cent. Iron and iridium are thus capable of combining at low temperatures, and the same is probably the case with iron and platinum. Under these conditions the alloy is evidently not homogeneous. Breithaupt admits the existence of platinum ores containing 14 to 19 per cent of iron. Berzelius, only once however, found a specimen containing as much as 12·98 per cent; and M. Debray and the author have never found more than 12. Platinum may be freed from iron by cupellation in chlorine gas. If heated from 1200° to 1500° in this gas, it is volatilised in the form of brilliant crystals, and deposited in all the hot parts of the apparatus.

Researches on the Fatty Acids and their Alkaline Salts.—M. Berthelot.—Already noticed.

Anhydrous Acetic Acid.—M. Berthelot.—The author has made fresh experiments to determine the heat liberated during the transformation of anhydrous acetic acid into the hydrated acid. The metamorphosis is not immediate, as the anhydrous acid can exist for some time in presence of water, and even of soda.

Contemporaneous Formation of Certain Mineral Species, Galena, Angelsite, Pyrites, and Silicates of the Zeolite Family, especially Chabasic, in the Hot Springs of Bourbonne-les-Bains (Haute Marne).—M. Daubrée.—After describing the specimens, the author remarks that it has been hitherto found impossible to reproduce by direct experiment, especially at so low a temperature, the majority of the mineral species which have so decided a tendency to form in the springs above mentioned.

Peculiar Mode of Excretion of the Gum Arabic Produced by the Acacia Verek of Senegal.—M. Ch. Martius.—The development of the gum is promoted by a parasitical plant of the genus *Loranthus*.

Report on the Measures Proposed to Prevent the Introduction of the "Colorado Potato Bug" (Doryphora decemlineata) into France.

Micrographic Study on the Manufacture of Paper.—M. Aimé Girard.—The author, after referring to the researches of Alcan and Vetillart, remarks that, hitherto, investigations of this nature have been undertaken in the interest of textile manufactures rather than of paper making. He lays down the following qualifications as necessary for a good fibre for paper:—The fibres should be in length from 1·5 to 0·3 m.m., but the length should bear a high proportion to the thickness. The fibre should be elastic, its tenacity being a secondary consideration.

Action of Sulphate of Ammonia in the Cultivation of the Beet-Root.—M. P. Lagrange.—The author finds that the sulphate of ammonia is a manure favourable to the growth of beet-root, and that it increases the proportionate yield of sugar. It is easily decomposed by the plant which assimilates the ammonia, whilst the sulphuric acid is neutralised by the alkalies and the carbonates, alkaline and alkaline-earthy, of the soil.

Nodules of Wollastonite, Pyroxene Fassaite, Garnet Melanite, in the Lavas of Santorino.—M. Fouqué.—The wollastonite, and the pyroxene fassaite associated with it, are both very rich in alumina, yet well crystallised and pure, whence the alumina cannot spring from the accidental presence of some foreign mineral. The yellowish green globules, and the clear yellow isotropic crystals are still more basic than the wollastonite. The garnets are not manganiferous, and contain no excess of alumina above the amount indicated by their ordinary formula. The amorphous matter of the lava in intimate contact with the nodules of wollastonite differs little in composition from common eruptive lava.

Diffraction; Focal Properties of Network.—M. A. Cornu.—A mathematical paper; incapable of useful abstraction.

Magnetising Function of Tempered Steel.—M. Bouty.—Not suitable for abstraction.

Determination of the Quantity of Magnetism of a Magnet.—M. R. Blondlot.—Not adapted for abstraction.

Amylogen, or Soluble Starch.—M. L. Bondonneau.—The name of soluble starch is applied sometimes to

amylogen, the product coloured a pure blue by iodine, sometimes the product coloured red or violet formed under the influence of dilute acids. On studying the formation of this latter body, the author has remarked that if the liquid is dried at atmospheric temperatures, and in similar conditions, before and after the formation of the deposit, re-dissolving afterwards in cold water, the former (before formation) dissolves entirely, whilst the deposit of the latter remains insoluble. This insolubility shows that this substance is only formed in concentrated liquids. The amylaceous matter of organised seeds is soluble in cold water, and its apparent insolubility is due merely to its coating of cellulose.

Identity of the Bromic Derivatives of the Hydride of Tetra-Bromated Ethylen with those of the Per-bromide of Acetylene.—M. E. Bourgoin.—Already noticed.

Amounts of Heat Disengaged in the Decomposition of the Chlorides of Certain Acids of the Fatty Series.—M. W. Louguinine.—Already noticed.

New Method of Titration.—M. F. Jean.—Taking advantage of the reactions pointed out by M. F. Weil, the author has devised a method of titration analogous to that of August Streng, applicable to the determination of nitrates, chlorates, iodates, chlorites, hypochlorites, &c.; of lead, manganese, tin, cobalt, nickel, ferrocyanide of potassium; and to the assay of the oxides of manganese, of red-lead, salts of tin, plumber's solder, and of bronzes. This method is based upon the following reactions:—If to an acid solution of protochloride of copper is added a body capable of liberating chlorine, or of passing to a lower degree of oxidation, there is formed a quantity of cupric chloride equivalent to the chloridising or reduced body—a quantity which may be readily determined by means of a standard solution of stannous chloride. Knowing the quantity of bichloride formed, it is very simple to deduce the amount of nitrate, chlorate, or peroxide corresponding. The author determines empirically the quantity of bichloride formed at the expense of the protochloride of copper by a known weight of nitrate or chlorate, &c.

Chemical Researches on the Absorption of the Ammonia of the Atmosphere by the Volcanic Earth of the Solfatara of Pouzzoli.—M. S. de Luca.—The earth of the solfatara, in the vicinity of the secondary fumerolles, by the action of air and moisture absorbs the ammonia of the atmosphere. This absorption is due to the previous transformation of sulphur and arsenic, under the influence of air and moisture, into acids, which convert the ammonia into ammoniacal salts, which, under ordinary conditions, are fixed and soluble. If preserved from moisture acids are not formed, and no ammonia is absorbed.

Reply to Two Communications by M. Béchamp on the Spontaneous Alteration of Eggs.—M. U. Gayon.—See *Comptes Rendus*, January 27th and July 21st, 1873.

Bulletin de la Societe Chimique de Paris, No. 2, January 20, 1875.

Researches on the Ureides of Pyruvic Acid—M. E. Grimaux.—A lengthy paper; not suitable for abstraction.

Remarks on Certain Qualities of the Nitrate of Methyl.—C. Girard.—The nitrate of methyl, discovered in 1835 by MM. Dumas and Peligot, occupies at present a very important position in tinctorial industry. Carey-Lea demonstrated, in 1862, that it might be substituted for methylic iodide in most reactions, and especially in the preparation of methyl-aniline, dimethyl-aniline, &c. Subsequently this compound has been utilised by H. Levinstein in the preparation of the violet substitution-derivatives of rosanilin; by MM. Poirer and Chappat for obtaining the methylic aniline bases, such as methyl-aniline, &c.; and recently in France, Switzerland, and Germany in the manufacture of greens derived from rosanilin violets, or of those derived directly from dimethyl-anilin violets. Since 1862 it has almost entirely superseded methylic iodide. MM. Dumas and Peligot, in their researches on methylic alcohol and its ethereal compounds, pointed out the facility with which this body ignites and explodes if its vapour is superheated. In consequence of the recent explosions in Germany and in France, the author has examined if its explosive properties could not be destroyed, or at least reduced, by the admixture of other bodies, as is the case with nitro-glycerin. He finds that many bodies, including the ethylic, methylic, and amylic alcohols, aceton, benzin, toluen, &c., under certain circumstances completely prevent the superheated vapour of methylic nitrate from detonating. A mixture of 2 to 3 parts of these bodies with 1 of methylic nitrate does not give rise to explosions, even when burned in large quantities. The author finds, also, that nitrate of methyl like nitro-glycerin can be made to detonate by percussion. A piece of blotting-paper, steeped in methylic nitrate, laid upon an anvil, and struck heavily with a hammer, produces an explosion as violent as that given by nitro-glycerin under the same conditions. But if diluted with twice its weight of aceton or of methylic alcohol it does not detonate when struck. With certain pulverulent and porous solids, such as tripoli and guhr it forms dynamites analogous to those obtained from nitro-glycerin.

Certain Salts of Vanadium.—J. N. Norblad.—Already noticed.

Compounds of Cyanide of Mercury with the Sulphocyanides.—P. T. Cleve.—The author describes the salts of potassium, ammonium, sodium, barium, strontium, calcium, magnesium, zinc, zinc-ammonium, cadmium, manganese, iron (ferrous), cobalt, nickel, cuprammonium, and lead.

Volumetric Determination of Acetates and of Acetic Acid in Presence of Mineral Acids.—M. C. Witz.—The changes of colour which methyl-aniline violet undergoes in contact with acids may be applied both in qualitative and quantitative analysis. Thus acetic acid, while it reddens litmus, has no action upon methyl-aniline violet, whilst the latter is turned a greenish blue by the smallest traces of mineral acids. Hence, vinegars adulterated with mineral acids may be easily detected, and the extent of the sophistication determined. For this purpose it is sufficient to find, with a standard acidimetrical liquid, first, the point of neutrality for litmus, which shows the total amount of acids; and, secondly, the point of neutrality for methyl-aniline violet, which corresponds to the mineral acids present. If the second result is deducted from the first, the remainder shows the amount of acetic acid. Acetates may be determined by the ordinary alkalimetrical process, using methyl-aniline violet as indicator, the liquid turning blue as soon as there is a trace of free mineral acid. The solution of the violet is made of the strength of 1 part in 1000.

Aniline Black with Ferrocyanide of Aniline.—M. A. Kielmayer.—The chlorate of aniline is prepared as follows:—5 parts of crystalline tartaric acid are dissolved in 10 parts of boiling water; 4 parts of potassic chlorate are dissolved separately in 12 parts of boiling water. These solutions are mixed while hot, and 20 parts of cold water and 3 parts of aniline are added. The solution turns a pale yellow colour, and stands at 6½° B. A solution of hydro-ferrocyanic acid is obtained by treating 7 parts of potassium ferrocyanide with 3 parts of sulphuric acid, diluted with 14 parts of water. After some days the yellow colour disappears, and sulphate of potash deposits. To 100 parts of this solution of hydro-ferrocyanic acid are added 128 parts of water, and 20 of aniline. For a steam aniline black take 34 parts of the above solution of chlorate of aniline; 12 parts of the above solution of ferrocyanide of aniline; 34 parts of water; 12 parts of gum tragacanth mucilage, containing 128 grms. gum per litre. This colour may be thickened with starch-paste.

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Aniline Ferro- and Ferri-Cyanides for Aniline Blacks.—MM. Wehrlin and Schlumberger.—Wehrlin prepares these salts of aniline in a state of purity with hydro-ferrocyanic acid, obtained by the action of tartaric acid upon yellow prussiate of potash. Aniline ferrocyanide forms thin, colourless laminæ, which gradually become yellow, and turn black if exposed to higher temperatures. It is neutral, sparingly soluble in alcohol, ether, and carbon bisulphide. It is soluble in cold water, and dissolves more freely in warm water. Aniline ferricyanide forms deep violet laminæ. It is slightly soluble in ether and carbon bisulphide, but dissolves in alcohol, aldehyd, and water. M. Schlumberger prepares aniline ferrocyanide by utilising its scanty solubility in cold water. He takes 2 parts of hydrochloric acid at 19° B. and 2 parts of aniline, and dissolves separately 2·4 of ferrocyanide of potassium in 4·2 of boiling water. When this latter solution has cooled down to 56°, the hydrochlorate of aniline, which must be quite cold, is added. After a time, aniline ferrocyanide is deposited, whilst potassic chlorate remains in solution. The former salt is allowed to drain, and preserved in a moist state, the yield being about 4·7 parts. This moist salt may be kept for some days without much change of colour, especially if protected from light. To make the black, 10 per cent of this salt is added to thickened chlorate of aniline. Ferricyanide of aniline is too soluble in cold water to be obtained by an analogous process.

No. 4, February 20, 1875.

On the Carbonyles, a New Class of Organic Compounds, and on the True Function of Ordinary Camphor.—M. Berthelot.—Not suitable for abstraction.

Researches on the Relations between the Different Tinctorial Principles of Madder, and on the Part which they play in Dyeing.—M. A. Rosenstiehl.—Abstracted in our last volume, p. 243.

Researches on Albumen and the Albumenoids.—M. P. Schützenberger.—Already noticed.

On the Perbromide of Bromated Acetylen.—M. Edme Bourgoin.—Noticed elsewhere.

Artificial Production of Monazite and Xenotine.—M. F. V. C. Radominski.—To obtain the former the author heated together in a platinum crucible 20 parts of phosphates of cerium, lanthanum, and didymium, and 150 parts of the chlorides of the same metals. The chlorides having been dissolved out with water, the oxy-chlorides with weak nitric acid, crystals of the triple phosphate were obtained after washing with water. Xenotine was obtained by fusing together 1 part of the phosphate of yttria, and 10 of the chloride of yttrium.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 15, March, 1875.

Procedures for Glazing Common Earthenware as used by M. Constantin.—E. Salvetat.—The following mixtures are recommended :—

(1).	Silicate of soda at 50° B. ..	100 parts
	Powdered quartz	15 „
	Chalk from Meudon	15 „
(2).	Silicate of soda at 50° B. ..	100 „
	Powdered quartz	15 „
	Chalk, of Mendon	15 „
	Borax	10 „

On Glass Hardened or Tempered so as to Resist Blows and Heat.—Pfocedure of M. Alfred de la Bastie.—Glass is said to be rendered much less fragile, and even malleable, by being heated in certain liquids or baths. Neither the nature of the baths nor the temperature requisite is stated.

On Blast Furnaces Fed with Wood, and used for Easily-Reducible Iron Ores.—P. von Tunner, in reply to I. Lowthian Bell's "Chemical Phenomena of Iron-Smelting."

Les Mondes, Revue Hebdomadaire des Sciences. No. 7, February 18, 1875.

Notice on the Resistance and the Faults of Construction in Batteries; Platinised Contacts.—Emile Girouard.—The author points out that one great obstacle in the way of our obtaining cheap electricity lies in the defect of the contacts. The rivets which connect the zinc to the carbon are often ill-made, and after having been in use for some time they are corroded all round, and the oxidation prevents the contact from being perfect. The current, consequently, is unable to pass, unless the tension is considerable enough to overcome the bad conductivity of the oxides. The author proposes to obviate these defects by having all connections, &c., made of platinum.

The bulk of the number is taken up with a translation of a Discourse delivered before the German Association of Naturalists, by Prof. Du Bois-Reymond, to which M. l'Abbé Moigno has thought fit to append a series of notes similar in tendency to those which accompanied his version of Prof. Tyndall's Belfast oration.

No. 8, February 25, 1875.

This number contains a note on the level of the Mediterranean at the Roman epoch; a notice of the turf-bogs of the north of France: facts showing the bad ventilation of theatres; observations on the artificial colouration of wines; and a discovery of petroleum in Algeria.

Reimann's Farber Zeitung, No. 5, 1875.

It appears, from the leading article in this number, that the dyers of Germany, and especially of Berlin, are considerably annoyed by sanitary regulations. They are compelled to collect their waste waters in tanks, and to purify them by the lime process, a method which eminent authorities consider practically impossible.

Manufacture of Alizarin.—The manufacture of artificial alizarin is much limited by the deficient supply of the raw material, since anthracen, which is converted first into anthrachinon, and then into alizarin, is only present in coal-tar to a small extent. There is now, however, a prospect of a good supply of the raw material from a new source. By the oxidation of naphthalin we obtain phthalic acid, $C_{16}H_4O_6$. Benzol, $C_{12}H_6$, is abundantly present in coal-tar. If phthalic acid is converted into phthalic chloride—

$$C_{16}H_4\begin{cases}O_4\\Cl_2,\end{cases}$$

this compound, if heated for twelve hours to 220° C. with zinc-powder and benzol in a sealed glass tube, yields anthrachinon, as below :—

$$C_{16}H_4\begin{cases}O_4\\Cl_2\end{cases}+C_{12}H_5H=C_{28}H_8O_4+2HCl.$$

In this manner we obtain, not the mere raw product, anthracen, but the penultimate stage, anthrachinon.

This number further contains receipts for printing a green and white design on a dark blue ground; for a dressing for cotton; and a bright reddish blue on wool.

No. 6, 1875.

In this number Dr. Reimann denounces an evil which we attacked about eight years ago, and which appears to be no less prevalent in Germany than in England, to wit, bribery and corruption in the tinctorial trades. The technical name for sums expended in this manner is "discretion-money."

"Gentiana violet" is a new aniline colour, recommended as cheaper than the Hofmann and methyl-violets, whilst equally beautiful.

The article on the patent colours of Croissant and Bretonnière has already appeared in our columns.

There is a prescription for dyeing leather a cochineal-red.

The *Deutsche Industrie Zeitung* accuses the calico-printers of Alsace and England of sending out calicos

and battistes with white designs on a violet ground, fixed, not with albumen, but with a mixture of acetate of alumina and arsenic dissolved in glycerin. Certain goods with reddish brown and yellowish brown designs are also said to be strongly arsenical. Dr. Reimann considers the outcry exaggerated. He informs his readers that the white dots, rings, and stars on an aniline-violet ground are generally produced by dyeing the pieces one uniform violet, and then printing on discharges. At the same time he denounces the arsenical mordant altogether, and points out that, where albumen is too costly, lactarin, or glue to which a trace of chromate of potash has been added, will produce perfectly fast colours.

No. 7, 1875.

This number contains receipts for a white, a yellow, and a mode-grey on gloves; for printing a lilac-grey on woollen yarns; a bark-yellow on cotton yarns; and an orange on a vat-blue ground.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in purifying paraffin, and in apparatus therefor. John and George Miller, manufacturing chemists, both of Aberdeen, North Britain. June 12, 1874.—No. 2040. This invention has for its object the purifying of paraffin in a simple, efficacious, and economical manner, and relates to two stages of the purifying operations. In the first stage oils and constituents of too fusible a nature are removed from the paraffin wax by a draining process, aided by improved arrangements and apparatus, and in the second stage colour is removed by means of calcined sulphate of magnesia.

A new or improved artificial stone, and the modes and means of manufacturing the same. Alexander Bennett McGrigor, solicitor, Glasgow, Lanark, N.B. (A communication from James Moeller Robertson, architect, Melbourne, Victoria.) June 12, 1874.—No. 2047. This invention consists in an improved mode and means of manufacturing artificial stone, first, by taking a base (termed herein a "matrix") of sand, gravel, saingle, and stones, glass, burnt clay, and like materials either separately or mixed, and then in triturating this matrix with water, having either a chloride, a bromide, an iodide, or a fluoride, preferably in saturated solution, chloride of calcium being preferred on account of its cheapness. The material so treated is then placed into moulds, and subjected to high pressure in screw, hydraulic, or other presses, and the blocks afterwards placed on wet sand-beds, where they set or harden in a short time, the setting being accelerated by having the blocks a short time in the solution before placing them on the sand-beds.

Improvements in the manufacture of metallic alloys. Alexander Parkes, Gravelly Hill, near Birmingham, Warwick. June 13, 1874.—No. 2064. This Provisional Specification describes producing a silver-like alloy which can be rolled and worked when red-hot from copper, manganese, zinc, and sometimes nickel. A silver-like alloy, which will also work at a red-heat, is also produced from nickel, copper, and zinc. When the silver-like alloy is not required to work at a red-heat it may be produced from copper, manganese, iron, and zinc. A solder for these compounds is produced from copper, manganese, and silver.

A new or improved dry process of oxidising "anthracene," and improvements in the manufacture of dyes and other colouring matters from the product so obtained. Carl Rumpff, Glasgow, Lanark, N.B. (Partly a communication from Friedrich Bayer, Friedrich Weskott, and August Siller, all of Barmen, Rhenish Prussia.) June 15, 1874.—No. 2071. The features of novelty which constitute this invention are obtaining anthraquinone from anthracene by a new or improved dry process, and in converting the anthraquinone so obtained into colouring matters suitable for dyeing and printing.

Improvements in the method of condensing muriatic acid gas and other fumes. Robert Stirling Newall, Washington Chemical Works, Newcastle-on-Tyne. June 15, 1874.—No. 2077. The object of the invention is to produce a spray forming a kind of mist, which being introduced at the top of the condenser will mix with the gas admitted thereinto and condense it. The spray is produced by causing a jet of water or other fluid to impinge with great force on a disc of larger diameter than the jet, and slightly cup-shaped.

Improvements in the manufacture of anthracene. Paul Curie, Cornhill, London. June 16, 1874.—No. 2079. Sulphur is mixed with the liquid hydrocarbons or substances, and the mixture then heated to a suitable temperature. Sulphuretted hydrogen is thus produced, and the remaining substance when distilled gives a larger proportion than has hitherto been obtained by the methods employed.

Improvements in treating fruit or vegetable juices in order to preserve the same from fermentation and decay. James Mitchell Fairlie, Glasgow, Lanark, N.B. June 17, 1874.—No. 2102. The feature of novelty which constitutes this invention is the treatment of fruit or vegetable juices by sulphurous acid gas, or by a weak solution of sulphurous acid.

Treating the juice of a certain tree called zapote or chickley in order to prepare or adapt it for useful purposes, and producing materials and useful and ornamental articles therefrom. Henry Conybeare, engineer, and Gabor Naphegyi, both of Kensington, Middlesex. June 17, 1874.—No. 2106. This invention relates to the treatment and application of the juice of a tree called zapote or chickley, to adapt it for purposes for which caoutchouc, gutta-percha, and other industrial materials are used. The juice, or as it is termed by the inventors "Zapotine," may be dissolved in alcohol or ether; or treated with carbonic acid or other compounds of carbon; or with white-lead and sulphur. It may be distilled. It may be mixed with caoutchouc, gutta-percha, cork, or other substance. It may be bleached by sulphuric acid and chloride of lime; dissolved in benzine or other hydrocarbon; and treated by an alkali or alkaline compound.

Improvements in pipes for conveying or condensing acid gases in chemical operations. William Windle Pilkington, glass manufacturer, St. Helens, Lancaster. June 17, 1874.—No. 2111. This consists essentially in constructing such pipes, tubes, or ducts of glass, preferably of thin blown glass. In carrying my invention into practice I make one end of each glass tube or duct smaller than the one to which it is connected, either by tapering them or by the use of a socket, or I use butt- and ring-joints or other means for coupling them. In combination with the above glass-tubes I employ as supports at the junctions, or intermittently between the junctions, wood or other carriers.

An improved preparation and apparatus for testing alcohols, and ascertaining the quantity of foreign bodies mixed therewith. William Edward Gedge, patent agent, Wellington Street, Strand, Middlesex. (A communication from Jean Bonjour, Faubourg St. Martin, Paris) June 18, 1874.—No. 2124. This invention consists in the use of a reactive composed of alcohol from grain, mixed with a certain quantity of acetate of lead. This reactive is introduced with the liquid to be analysed into a globular vessel, in which they are kept in agitation by a mixer. The liquid thus mixed escapes by the lower part of the vessel into a worm, and goes to a pressure-filter, whence it falls into a vase, where it completes its clarification. The liquid is then poured off and weighed very exactly, and by means of tables, drawn up for the purpose, it is at once ascertained whether the alcohol of wine has been mixed, and to what extent.

Improvements in the manufacture of sulphates of soda and potassa, and in apparatus employed therein. Thomas Robinson, engineer and ironfounder, Widnes, Lancaster. June 20, 1874.—No. 2145. This relates to Messrs. Hargreaves and Robinson's direct-action method of manufacturing sulphates of soda and potassa, and consists—First. In connecting the chamber containing finished chloride into the condensing tower so as to draw off obnoxious gases. Second. When a fan is used to draw gases through the chambers in employing bearings at a distance from the fan chamber, keeping the said bearings cool by liquid, add admitting the gases by preference through one eye only. Third. In constructing converting chambers with an internal air-pipe for cooling the sulphate. Fourth. In enclosing the internal pipe mentioned under the above third head in a second pipe or structure so as to surround the said pipe by an annular space. Fifth. In connecting the said internal pipe or annular passage to the chimney or artificial draft producer. Sixth. In connecting the internal pipe mentioned under the above third and fourth heads with the space in or over the cylinder and flue covers. Seventh. In hanging the carrying grids by hinge-like catches to the internal pipe mentioned under the above third and fourth heads, and supporting the outsides of the said grids by props. Eighth. In forming the internal pipe mentioned under the above third and fourth heads with flanges at or near its top, so as to support the cylinder and flue covers.

Improvements in the mode of treating phosphates of lime for manuring and other purposes. Edward Primerose Howard Vaughan, F.C.S., patent agent, Chancery Lane, Middlesex. (A communication from Count Victor Francois Leonard Huyttens de Terbecq, Paris.) June 22, 1874.—No. 2168. This invention consists in the direct application of sulphuric acid to the treatment of uncrushed phosphates of lime for manuring and other purposes, when those phosphates are subjected to constant attrition in a revolving drum or other analogous apparatus.

NOTES AND QUERIES.

Testing Fibres in Cloth.—The best result would be obtained by microscopical examination. The goats' hair and the wool would be difficult to distinguish, especially in a dyed fabric; the operations of spinning and weaving often obliterate more or less the surface markings, which give the characters relied upon for distinction. Authentic specimens of the various hairs should be studied, and the changes effected by various dyes and reagents. The subject is difficult, but not so much so as in the case of vegetable fibres.

Decrease of Temperature when Certain Salts are Dissolved.—(Reply to A. S.)—All freezing mixtures depend upon this fact, which is one of the best known in physics.

Beer.—(Reply to M. B.)—Consult Prescott's "Chemical Examination of Alcoholic Liquors," published by Van Nostrand, New York.

MEETINGS FOR THE WEEK.

MONDAY, 19th.—Medical, 8
—— London Institution, 5.
TUESDAY 20th.—Civil Engineers, 8.
WEDNESDAY, 21st.—Society of Arts, 8.
—— Meteorological, 7.
THURSDAY, 22nd.—London Institution, 7.
—— Royal, 8.
FRIDAY, 23rd.—Royal Institution 8.
—— Quekett Club, 8.
SATURDAY 24th.—Physical Society, 3. J. Barrett, "On a Form of Mercurial Air-Pump." Dr. Stone, "On some Points Connected with Wind Instruments."

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THE CHEMICAL NEWS.

VOL. XXXI. No. 804.

INTERMITTENT EBULLITION.

By Dr. T. L. PHIPSON.

WATER strongly acidified with hydrochloric acid, and containing a small quantity of benzol, was found to enter into violent ebullition every sixty seconds; after a while the boiling ceased completely, and then recommenced suddenly every 30 seconds for some time. The flask still being kept over the spirit lamp, the periods between quiescence and violent ebullition dropped to 20, 10, and finally to 8 seconds, at which interval the phenomenon continued for some considerable time. The temperature of the vapour in the flask was 101° C., in the liquid 103·5° C., during the whole time of the experiment.

When methyl alcohol was added to the above mixture of water, hydrochloric acid, and benzol, and the flask placed over a spirit lamp, no ebullition at all occurred for a very long space of time, and then it took place very suddenly and continued.

ON THE MANUFACTURE OF SULPHURIC ACID IN ENGLAND.*

By Dr. LUNGE.

IT is needless to say that, in the manufacture of sulphuric acid, the use of Sicilian sulphur has been abandoned. Even ordinary pyrites containing only traces of copper, or none at all, have given place to pyrites from Spain, Portugal, and Norway, containing 3 to 4 per cent of copper. Nine-tenths of the sulphuric acid made in England during 1874 were obtained from imported pyrites. The burnt ores are submitted to a chlorinising roasting process, and then washed with dilute hydrochloric acid. The copper contained in the liquid, after precipitation of the silver, is reduced to the metallic state by means of iron in a fine state of division. The portion which remains insoluble after washing is oxide of iron almost free from sulphur, accompanied, of course, by the gangue of the pyrites. The oxide may be utilised in the blast furnaces, and thus none of the constituents of the pyrites are wasted. The traces of silver found in the copper from the burnt ores are also extracted. In some places this operation is still performed on Claudet's principle; the high price of iodine, however, and the loss of this body which it involves, induces metallurgists to seek out another and a less costly procedure.

Mr. Gibb has indicated a method based upon the following observation:—When a solution of copper containing small quantities of silver is treated with sulphuretted hydrogen, the greater part of the silver is thrown down along with the first portions of sulphuret of copper. The solution of copper, obtained by washing with weak hydrochloric acid the product of the chlorinising roasting process of the burnt pyrites, is led into large troughs, and sulphuretted hydrogen, obtained from the residues of the alkali manufacture, is forced into it by means of pumps. The precipitation is stopped when about 6 per cent of the copper is thrown down in the state of sulphide. Thus, copper which originally contained 20 ozs. of silver per ton is deprived of all save 2 to, at most, 4 ozs. of the precious metal per ton. The 6 per cent of copper precipitated contains 200 ozs. of silver per ton. The solution of copper, freed from the silver, is treated with spongy iron, which throws down metallic copper. The argentiferous sulphide of copper, is deposited in the form of a voluminous mud, which is washed and then compressed in a very large Needham filter-press. The moist sulphide thus obtained is calcined in roasting furnaces; about one-fourth is converted into sulphate, and the rest is in the state of oxide and oxychloride. All the silver appears to be found as chloride after roasting. Originally the products of calcination were converted into sulphate by means of sulphuric acid. The silver remained in the residue, which then contained 600 ozs. per ton; but the difficulty of finding a market for the blue vitriol compelled Mr. Gibb to turn to a more complicated process.

The roasted product is washed with water, and the solution, containing at most 1 oz. of silver per ton, is precipitated with iron. The residue (chiefly oxide of copper) is exhausted with a saturated solution of common salt. After this treatment it contains merely 3 to 4 ozs. of silver per ton of copper, and is treated like a copper ore, neglecting the silver.

The saline liquid contains the chloride of silver, mixed with chloride of copper. All these metals are precipitated with milk of lime; the precipitate is washed and treated with dilute sulphuric acid, which dissolves the copper. After washing, there remains a residue containing silver in the state of chloride which is sent to be smelted. Sulphates of lime and of lead derived from the pyrites are found in the same product. By this process, 1 ton of burnt ore yields about ½ oz. of silver, costing at most 75 centimes, and representing a profit of 2 frs. 20 centimes per 1000 kilos. of burnt pyrites.

The use of pyrites involves a great difficulty—the burning of the "smalls," which have been moulded into bricks with 10 per cent of clay. This process is defective as regards combustion, and the resulting burnt ore is difficult to treat and loses much of its value. It is preferable, in order to agglomerate the small pyrites, to stir them up with water, and spread them out to dry in a thin layer on the furnaces. A certain quantity of sulphate of iron is then formed, which agglutinates the grains of pyrites and forms them into compact masses.

The author then describes the various kinds of pyrites kilns, such as those of Spence, of Ollivier-Perret, of McDougal, and others used in England.

* Abstract.

ON THE ANALYSIS OF CRUDE ANTHRACEN

By GEORGE E. DAVIS and T. H. DAVIS.

VERY little has been written, whatever may have been done in this country, upon the subject of the analysis of crude anthracen. The crude article is of immense importance; yet how empirically are tests made and the results issued to the buyers, which often prove anything but satisfactory. Not so long ago we had "high" and "low" analysts in the phosphate and manure trade; but the discrepancies between two analysts, or two methods of analysis, never reached the wide differences often seen in anthracen analyses, where parcels of the crude material were certified to contain so much per cent of anthracen, as calculated from the amount of matter insoluble in carbon disulphide or in alcohol, and fusing at a certain temperature, often only 1° C. short of the fusing-point of pure anthracen, and sometimes more difficultly fusible than the pure article, as against the actual amount of the pure anthracen contained in the sample.

Within our knowledge, samples have been sold on the carbon disulphide test as containing 56 per cent of anthracen which contained actually only 42 per cent. Who can wonder that there is often a loss in production in the manufacture of artificial alizarin, and why should the "test" be carried on so empirically?

It is not intended to assume that all works, all buyers, and all sellers of this article prefer the "bisulphide test," as it is well known that some will only buy the "chinon" test; but it is a fact, that discussion upon many of these points has not publicly been entered upon with zeal and

spirit, and in several large towns attempts have been made to raise a discussion upon the subject, but have failed.

The solvent methods were the first employed in anthracen analyses, and, when we remember the conservative habits of English manufacturers, it is not surprising that the processes have been so persistently retained; but the processes have many faults, and the results cannot possibly be correct, except by accident.

At the high temperature at which the oil is run into the coolers in the manufacturing operation the anthracen is in solution, and which separates, together with other substances, as the solution cools. Now, when these easily fusible hydrocarbons are liquefied, either by heat or by the aid of solvents such as those used in the quantitative analysis of the crude article, a proportionate quantity of pure anthracen is dissolved by them, in addition to the quantity dissolved by the solvent itself, so that a very different result is obtained by operating upon the original substance, in one case, and by first extracting the more easily fusible substances in the other. These hydrocarbons dissolve much more anthracen when already dissolved in carbon disulphide than when simply warmed and pressed, so that it is always advisable to press out as much as possible of the oil before treating with the solvent.

These solvent methods have been described in Chemical News, vol. xxix., p. 169, to which we refer, and the results of all the processes and experiments have been controlled by E. Luck's anthrachinon method, which has now been proved by Luck himself, by R. Lucas, and by ourselves, to give absolutely accurate results, as we shall show further on.

Now, starting with the carbon disulphide method. This reagent does not dissolve out all the impurities of the crude anthracen unless it is added in sufficient quantity to dissolve all, or nearly all, the pure anthracen contained in the sample, therefore the weighed residue does not give any idea of the percentage of contained anthracen, even when the fusing-point of this residue is taken; it may come near it, as it often does when the percentage of real anthracen averages 30 per cent, but these indications are not decisive.

Lucas (Chemical News, vol. xxx., p. 190) gives several interesting experiments in this direction. He found the carbon disulphide residues to contain the following percentages of real anthracen:—

1.	2.	3.	4.	5.	6.
49·64	53·92	55·64	56·00	59·06	60·00

The weighed carbon disulphide residues obtained by us are as follows:—

Percentages of Real Anthracen.

1.	2.	3.	4.	5.	6.
59·23	36·80	57·60	55·42	63·00	58·12

Many of these residues have been examined by the anthrachinon method; but our highest result was 63·0 per cent only, and the lowest 36·80 per cent.

Although these weighed residues contain really only from 50 to 60 per cent of real anthracen, yet we have stated that the results do come near reality sometimes, and that when the percentage of anthracen averages 30 per cent. This is caused by an error in the opposite direction, viz., the solubility of the anthracen itself in the carbon disulphide, and we purpose first to examine this solubility and see how it will affect the results of an analysis.

In the bisulphide method, 10 grms. of the crude article come in contact with 60 c.c. = 76 grms. of carbon disulphide. Now, Kopp and Bolley, in their treatise "On Tar Colouring Matters, state that 100 parts of carbon disulphide dissolve 1·7 parts of anthracen; but we will take Dr. Versmann's numbers, say, 1·5," as they nearly coincide with our own determinations.

The 60 c.c., therefore, of carbon disulphide used will dissolve, by its own solvent power, 1·14 grms. of pure anthracen, and this is dissolved from 10 grms. of substance; so it will be seen that this error introduced is very great. Lucas, in the paper we have referred to, dilates upon this subject, and our experiments confirm his results.

* Chemical News, vol. xxx., p. 204.

A sample of crude anthracen containing 25·30 per cent by anthrachinon was examined also by the bisulphide method, which gave 21·50 per cent insoluble, and which in itself contained 59·23 per cent of real anthracen. This shows—

21·50, containing 59·2 per cent = 12·72 anthracen insoluble.
78·50, „ 16·02 „ = 12·58 „ soluble.

25·30

Or 1·258 grms. which have dissolved in the 60 c.c. of carbon disulphide.

A second experiment gave as follows:—

Percentage of real anthracen by anthrachinon, 30·13.
By bisulphide residue, 25·20 per cent; and this residue contained 57·18 per cent of real anthracen.

This shows—

25·2, containing 57·18 per cent = 14·41 anthracen insoluble.
74·8, „ 21·01 „ = 15·72 „ soluble.

30·13

Or 1·572 soluble in the 60 c.c. carbon disulphide.

Thus it may be seen that, in samples containing a large proportion of easily fusible hydrocarbons, one error compensates the other; but if the crude article has been relieved of a large proportion of readily fusible matters, by pressure or what not in the manufacture, the error of solubility ceases to compensate for the increase in substances left insoluble in the carbon disulphide, and a higher result is obtained than corresponds to the amount of pure anthracen in the sample.

About 31 per cent seems the point of neutrality, the point at which one error almost exactly balances the other, and as a proof we offer a few analyses:—

	By CS_2.	By Anthrachinon.
1.	31·57	31·17
2.	31·19	31·18
3.	30·10	29·61
4.	31·24	31·00

The neutral point of Lucas is at 16 per cent; this, in most samples of crude anthracen, we are persuaded is too low. With some varieties of tar this might happen, and possibly this neutral point would vary with every kind of tar, and with the way in which it is worked.

We will now pass to the alcohol method, and here we shall find a greater variation from the truth than with the bisulphide method. The constituents of crude anthracen are not dissolved by alcohol so readily as by carbon disulphide, consequently we have a larger residue and higher results. The residue insoluble in alcohol contains about the same percentage of real anthracen as that from carbon disulphide.

In the alcohol method of analysis 20 grms. of the crude substance are in contact with 400 c.c. of alcohol of sp. gr. 0·825 to 0·840, and it is almost needless to add, since it has been pointed out by Dr. Versmann in his lecture before the Society of Arts, that an alcohol of high gravity leaves a larger residue than a more anhydrous one. Now, 400 c.c. of alcohol 0·825 sp. gr. weigh 330 grms., which will dissolve 1·894 grms. of pure anthracen, and this from 20 grms. of the crude substance; we will therefore see, by direct experiment, how much real anthracen is dissolved out by the alcohol, and how much is contained in the insoluble residue.

In one experiment the crude substance contained 25·30 per cent of real anthracen, and by the alcohol method left 40·84 per cent of residue. This residue in itself contained 56·8 per cent of real anthracen, and this shows—

40·84, containing 56·8 per cent = 23·19 anthracen insoluble.
59·16, „ 3·56 „ = 2·11 „ soluble.

25·30

In another experiment the crude material contained 30·13 per cent of real anthracen, and the alcohol method

left 30·0 per cent of residue, which contained 84·4 per cent of real anthracen. This would show—

30·0, containing 84·4 per cent = 25·32 anthracen insoluble.
70·0, „ 6·87 „ = 4·81 „ soluble.

30·13

As 20 grms. were operated upon in either case, 0·422 grms. of real anthracen entered the solution in the first experiment dissolved by the 400 c.c. of alcohol, and 0·962 grm. in the second. But we have ascertained that 400 c.c. of alcohol at 0·825 sp. gr. dissolves 1·894 grms. of anthracen; therefore it would appear that in the presence of the other constituents of crude anthracen the solvent action of the alcohol was retarded.

The constituents, other than anthracen, in the crude material are not soluble to the same extent in the prescribed quantities of alcohol and bisulphide, substances which are very soluble in bisulphide and are not taken up so freely by alcohol, and *vice versa*. We have taken advantage of this in preparing pure anthracen, and shall allude to it again in another portion of this paper. The filtrate from an alcohol analysis was taken, which left 54·96 per cent of residue.

(*a*). 100 c.c. were evaporated at 100° C. The result was a dirty looking greasy mass, fusing about 100° C., and losing weight at that temperature.

(*b*). 100 c.c. were agitated with 100 c.c. of carbon disulphide, and separated by a stoppered funnel. The bisulphide portion was evaporated at 100° C., and gave a residue which weighed 6·258 grms., leaving 2·75 grms. dissolved by the alcohol. This bisulphide residue was a brown greasy solid at ordinary temperatures, and completely liquid at 100° C.

Another alcohol filtrate was taken and evaporated at 100° C., and 10 grms. of the residue taken, as in an ordinary analysis, and treated with carbon disulphide, 60 c.c.; 8 grms. were dissolved containing *all* the anthracen which had been previously dissolved by the alcohol, and leaving 2 grms. of residue which was soluble in alcohol, but insoluble in the carbon disulphide, although an excess had been used.

The bisulphide filtrate from an analysis was then taken and evaporated to dryness, and the residue treated with 200 c.c. of alcohol, as in an actual alcohol analysis. This gave 26·7 per cent insoluble in alcohol, and which had previously been soluble in the carbon disulphide.

We have already mentioned a process of extracting some of the more readily fusible hydrocarbons before treatment with the solvents, by pressure between folds of blotting-paper; and when a solvent method is employed, the bisulphide, for instance, a higher result is obtained by operating upon the material from which some of the oil has been extracted by pressure, than when we operate upon the original crude material.

To illustrate this, the following experiments were made:—

40 grms. of the crude anthracen were pressed between thick folds of blotting-paper, between iron plates in a strong vice for half an hour, when 35·255 grms. of repressed anthracen were obtained, showing—

Expressed oil	11·863
Repressed anthracen ..	88·137
	100·000

This repressed anthracen gave 33·12 per cent of residue by the bisulphide method, or 29·19 per cent on the original sample. Before expressing, it gave 27·05 per cent insoluble. Several other experiments are tabulated below:—

	Expressed Oil.	Repressed Anthracen.	Per cent. Residue before Pressing.	Residue on Repressed Article.	Calculated on Original.
1.	17·156	82·844	28·58	39·60	32·80
2.	20·368	79·632	20·54	30·43	24·28
3.	10·916	89·084	24·12	33·93	30·24
4.	11·350	88·650	26·73	32·75	29·03

These results would promise to be of importance, seeing that in some cases the bisulphide method gives a lower result than the anthracen contained in the sample; and these low results are generally associated with a large percentage of readily fusible and easily expressed oil.

The fusion-points, or rather the mean numbers of the fusion- and solidifying-points, of the alcohol residues, as well as of the bisulphide residues, are always taken as a kind of guarantee of the purity of these residues; but, though a low fusion-point shows the residue to contain a large proportion of a readily fusible hydrocarbon, a high fusion-point is not a sufficient guarantee of its purity. A few illustrations will prove this:—

In one experiment, the residue from a bisulphide determination, that is, the insoluble portion, contained 65·056 per cent of real anthracen, and fused at 208° C.

In another, the bisulphide residue contained 60·0 per cent of anthracen, and fused at 210° C., and it stands to reason that, if we have an excess of high melting hydrocarbons, say, for instance, plenty of chrysen, that the melting-point of this residue will be raised. In some experiments, at one stage of the coking of pitch the bisulphide residue contained only between 1 and 2 per cent of anthracen, yet the fusing-point was 225° C.

As has been shown before, the bisulphide residues fuse at a higher temperature than the alcohol residues; yet analysis does not show so much difference in the amounts of contained anthracen. The fact must be this:—Carbon disulphide dissolves out a greater proportion of the low-melting hydrocarbons, while alcohol seems to have no greater propensity for one than another, and takes a nearly equal share from each.

In taking these temperatures, and in operating generally, perhaps a few remarks will not be out of place. At these temperatures ordinary thermometers may, perhaps, be used for commercial works without introducing any very great error, although it is well known that in many thermometers their indications may be correct at all temperatures from 0° C. to 100° C., but about 200° C. they are often a few degrees out, owing to the increase of the coefficient of expansion of mercury. In delicate matters, no indications should be taken as correct unless the thermometer is compared occasionally with a standard instrument, and that it is able to show distinctly very small variations in temperature.

Furthermore, the bath which holds the thermometer and the trial tube should be large, and not small, as has often been recommended, and the heating very gradual; then the results will come out sharp and accurate, and will bear much criticism. Solid paraffin makes the best bath; it is fluid at the necessary temperature, and does not give off any vapour until heated to at least 176° C., whilst, when sulphuric acid is used, the vapour given off from it is such as prevents any very great attention to the thermometer. We append a few results of the fusing- and solidifying-points of both alcohol and bisulphide residues.

By Alcohol Method.

Indicated Percentage.	Commenced to Fuse.	Commenced to Solidify.	Mean.	Difference.
	Degrees.	Degrees.	Degrees.	Degrees.
53·90	191	190	190·5	1
48·70	191	188	189·5	3
44·75	188	188	188·0	0
38·30	185	183	184·0	2
41·60	187	186	186·5	1

By Bisulphide Method.

26·55	205	204	204·5	1
26·50	211	208	209·5	3
24·11	210	209	209·5	1
25·11	211	208	209·5	3
22·25	210	208	209·0	2

These bisulphide residues, although they fuse so nearly the temperature of pure anthracen, contain at the most 60·0 per cent of this latter substance; but, as enough has

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been written on these empiric methods—methods which depend for their indications upon errors—we will turn our attention to Lück's method of analysis, which gives results based upon the transformation of anthracen into anthrachinon, and gives in nearly every case absolutely accurate results.

(To be continued.)

THE CAUSE OF SOLAR HEAT.*

By DAVID WINSTANLEY.

WHEN a body possessing the visible energy of mechanical translation is arrested in its course, that energy, according to the laws of conservation, is not destroyed, but becomes apparent in another form, generally in the form of heat. Should a body receive two equal impulses in diametrically opposite directions at the same time, mechanical translation as a result thereof is impossible, and the energy thus expended—it appears to be agreed—will in the main assume the form of heat. Should a body, however, receive two equal impulses in directions inclined to each other, mechanical translation will ensue, but the value of the energy of visible motion thus communicated to the body in question is not equal to the sum of the impulses, being, as is well known, justly represented by the diagonal of a parallelogram the length of whose sides is proportional to the value of the primal impulses. What, then, in this case becomes of the residue of energy applied and not converted into visible motion? I apprehend it assumes the form of heat. If so, in the instance of a body receiving equal impulses in directions inclined to each other at an angle of 120°, the resulting visible motion will just account for the energy of one of these impulses, and the resulting heat for the energy of the other. If, then, a body, having a certain amount of visible energy observable as rectilinear movement, have a series of impulses imparted at an angle of 120°, in each instance to the line of motion and equal in value to the visible energy of the body at the time of application, the body in question will gain nothing in visible motion through the application of these impulses, but will simply alter the direction of its movement at each application, and acquire at the same time an amount of heat of which the impulse is the mechanical equivalent. Adopting this view, it matters not at what angle the impulse may be given, for so long as the figure representing its amount yields—with that representing the visible motion of our body—a parallelogram whose resultant is equal to the line of visible motion, it follows that the energy of mechanical translation remains unaltered, and the energy of the impulse becomes wholly transformed into heat. This condition of things, however, is what obtains in the instance of a body in planetary revolution in a circular orbit. It is continually receiving impulses, through the instrumentality of gravitation, at or nearly at right angles to its line of flight, and its energy of visible motion does not increase, whence I infer that the mechanical energy by which its rectilinear movement is destroyed is converted into an equivalent of heat which elevates the temperature of the planet so far as its conditions of radiation will permit. The aggregate value of the impulses required to make a body describe a circle and return to its primal position and direction without loss or gain of visible energy, I have endeavoured to determine graphically by means of the mechanical parallelogram. The result at which I arrive is—that the aggregate in question exceeds the momentum of the body to be deviated in the same proportion as the circumference of a circle exceeds its radius, and this irrespective of the circle's size. I have not attempted to calculate the temperature to which the matter of the earth would be elevated by a sudden stoppage in its orbital path, for it appears to me that satisfactory data for doing this do not exist. The number of thermal units to which such a stoppage would give rise if multiplied by 6·28 indicate the amount of heat which—upon the present hypothesis—the earth annually receives through the instrumentality of solar gravitation. This amount will, I apprehend, amply account for a certain initial temperature of the terrestrial matter, and for that excess of internal heat which appears to have been pretty well made out. It will be evident that any heat which, in virtue of this hypothesis, may be supposed to fall to the lot of our earth, will, in some calculable proportion, fall to the lot of the other planets also. That proportion I apprehend to be directly as the planet's mass multiplied into its velocity in orbit, and divided by its periodic time. Of course this amount of heat will be distributed over the entire matter of the planet, the temperature of which will depend on the capacity for heat of the matter composing it, and on its facilities for radiation. These latter will clearly diminish with the comparative diminution of superficies enjoyed by the larger planets, and with the extension of their atmospheres. In the case of bodies moving in elliptic orbits, the amount of energy which according to this hypothesis will be transformed to heat in a single revolution will be practically as before, *i.e.*, 6·28 times the planet's visible energy of motion at its mean distance from the sun. There will, however, be this difference between the two cases:—In the instance of a body moving in a circular orbit the accession of heat will be a constant quantity in equal increments of time and in all parts of the orbit, whereas in the case of a body moving in an ellipse the accession will be least in approaching the perihelion and greatest in receding from it, inasmuch as the solar gravitation produces an increase of mechanical translation in the former instance and a diminution in the latter. Assuming the theory to be correct, this circumstance is one which will greatly mitigate the extremes of heat to which—apart from such a consideration—we should expect cometic bodies to be subject. Indeed, in spite of the enormous distances to which they recede from the sun, the voluminous nature of their atmospheres by which radiation must be diminished, may, in conjunction with this view of the case, afford an explanation of the unexpectedly high temperature which, in the case of these bodies, the spectroscope certainly seems to indicate.

The application of the views herein advanced to an explanation of the cause of solar heat is briefly this:—As the mutual and ever-acting gravitation of the sun and his attendant planets produces in the instance of the central luminary no more acceleration of visible motion than in the instance of the planets themselves, the gravitation must result in the exhibition of some other form of energy, which—in the one case as in the other—will, I apprehend, be the form of heat. Carrying, however, this idea to the extreme, we should be led to infer that the force of gravitation, which in some circumstances is certainly capable of transference into the form of mechanical translation, and thence into the form of heat, is in others just as capable of transformation in the opposite order. Indeed, if heat is to be regarded as the individual movement of a multitude of particles whose simultaneous movement is observable as mechanical translation, it is but reasonable to suppose that a force acting upon all, but from the circumstances of the case incapable of producing a simultaneous and concordant movement, will produce an individual—and in a sense discordant—motion of those same particles. Looking at the matter in this way, any agglomeration of particles whatever must have some initial heat as a result of that gravitation which is unable to evince itself as mechanical translation. And as, in our experience, gravity is unceasing, this heat, so far as we can see, should be never ending during the continuance of those conditions which prevent the movement of translation. And a never-ending supply of heat must cause an elevation of temperature which will only cease when a point is reached at which the rapidity of radiation equals the rapidity of supply. The more numerous the

* A Paper read before the Manchester Literary and Philosophica Society.

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particles composing the agglomerated body the less become the opportunities of radiation and the more elevated the temperature, which latter attains its maximum in our own system in the instance of the stupendous body which maintains the superficial mundane heat by irradiation from its fires.

It will be seen that the theory here projected places itself in antagonism with the doctrine that "a stone high up" has anything which can be justly termed "the energy of position." But I have already occupied sufficient time without staying now to combat further the doctrine I have named.

To those who have been accustomed to regard gravitation as a property which enables bodies to act where they are not, the present considerations will present difficulties not encountered by others who accept the beautiful—and to my thinking more rational—hypothesis that the simple mechanical movement of infinitesimal particles is the immediate cause of that grand effect, the law of universal gravitation.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 15, 1875.

Professor ABEL, F.R.S., President, in the Chair.

AFTER the minutes of the previous meeting had been read and confirmed and the donations to the Society announced, Messrs. J. M. Thomson, J. G. Gordon, D. Kingsford, E. Sonstadt, and D. Galton were formally admitted Fellows of the Society. The names read for the first time were those of Messrs. G. Bischof, P. Melmore, C. G. Cresswell, T. Wardle, D. Clerk, W. Grant, G. Johnston, and H. Child; Messrs. George Alexander Keyworth, J. Scudamore Sellon, and Richard Cowper were ballotted for and duly elected after their names had been read for the third time.

The first paper, "*On the Gases Enclosed in Coals from the South Wales Basin, and the Gases Evolved by Blowers, and by Boring into the Coal itself*," by J. W. THOMAS, was read by the author. After referring to Meyer's researches on the same subject, the author described the method he employed, which differs from Meyer's. A slip of coal cut from the centre of a block was introduced into a glass tube, which was then exhausted with a Sprengel's pump; but little gas was evolved. The tube containing the coal was now heated to 100° for several hours, and the evolved gases collected; it was found, however, that the whole of the gases enclosed in the coal were not withdrawn at 100° or even 200°. The bituminous coals evolved comparatively little gas, 100 grms. giving only from 55 to 61 c.c. of gas; steam coal gives much more, 147 to 375 c.c. per 100 grms.; and anthracite the most, 555 to 731 c.c. In all cases the gases consist of marsh gas, carbonic anhydride, and nitrogen, but the proportions vary greatly, bituminous coal containing comparatively little marsh gas, whilst steam coal and anthracite contain as much as 87 per cent. The gas evolved from "blowers" in most cases consists almost entirely of marsh gas.

The PRESIDENT, in thanking the author for his interesting paper, said he had no doubt it would elicit discussion as his results differed so greatly from those of Meyer, especially in the proportionally small amount of carbonic acid and nitrogen he had obtained.

Professor V. HARCOURT would like to know what grounds the author had for saying that the gas which was given off when the coal was heated was merely what was contained in the pores of the coal, and was not produced by decomposition. The gas absorbed by porous bodies, like charcoal, when expelled by heat, was again absorbed as it cooled; this did not seem to be the case with the coal. In some experiments he had made for the purpose of removing sulphur from gas, he had found that when heated in a current of gas such as steam or air, the coal had become extremely porous, although there was no change in its appearance. It now absorbed certain constituents of coal-gas, and when heated gave them up; on cooling they were again absorbed.

The PRESIDENT remarked that Meyer had observed that when coal was heated to a comparatively low temperature, he believed 50°, certain heavy hydrocarbons were obtained, amongst others butylen, whilst Mr. Thomas even at 300° only found carbonic anhydride, nitrogen, and marsh gas.

Mr. MORRIS said he would like to ask, what was the depth of the seam of coal? what its temperature? and what was the nature of the roof?

Mr. THOMAS replied that coal which had been seventy hours in a Sprengel vacuum, when heated, gave off about ten times its volume of gas, and when allowed to cool in it only about half a volume was absorbed. With regard to the depth of the seam, he had found that in the same seam the greater the depth the larger was the percentage of marsh gas in the gases contained in the coal, and also that the total amount of gas was greater.

A paper "*On Narcotine, Cotarnine, and Hydrocotarnine* (Part I.)," by G. H. BECKETT and C. R. A. WRIGHT, was read by the latter. The cotarnine employed in these experiments was prepared from narcotine by the action of dilute sulphuric acid and manganese dioxide, and after the separation of the opianic acid precipitating it by strong soda solution. It may be purified by crystallisation from benzene when it has the composition $C_{12}H_{13}NO_3,H_2O$. The platinum salt is $(C_{12}H_{13}NO_3HCl)_2PtCl_4$. The cotarnine was converted into hydrocotarnine by dissolving it in dilute hydrochloric acid, and treating it with granulated zinc. In order to extract the base a large excess of ammonia was added, and the solution agitated with ether; this takes up the hydrocotarnine, and deposits it on evaporation in fine prisms an inch in length. These crystals have the composition $2(C_{12}H_{15}NO_3,H_2O)$. It forms a crystalline hydrochloride, $C_{12}H_{15}NO_3HCl,H_2O$. Hydrocotarnine is always produced in the preparation of cotarnine from narcotine in the manner above described. The action of manganese dioxide and sulphuric acid on hydrocotarnine converts it into cotarnine, but much tarry matter is formed at the same time; narcotine does not take up hydrogen when treated with reducing agents, and when boiled with baryta water it yields meconin, but no opianic acid; heated with water to 150° it is decomposed, meconin and hydrocotarnine being found amongst the products. From these results it seems probable that in the preparation of cotarnine from narcotine, the latter first splits up into opianic acid and hydrocotarnine thus:—

$$C_{22}H_{23}NO_7+H_2O=C_{10}H_{10}O_5+C_{12}H_{15}NO_3,$$

and that the hydrocotarnine is then oxidised to cotarnine.

The physiological action of cotarnine and hydrocotarnine has been examined by Dr. F. Pierce who finds that whilst the former, in doses up to 0·5 grm., does not produce the slightest effect, hydrocotarnine produces severe epileptiform convulsions, great muscular prostration, and salivation.

Dr. ARMSTRONG said he was greatly interested in these results, as he had worked from time to time on the same subject. From the experiments of Matthiessen, Foster, and Wright, there was no doubt as to the formula of opianic acid. It partook of the nature both of an aldehyde and of an acid, $C_6H_2(OCH_3)_2.COH.COOH$. By treatment with hydriodic acid it yielded methyl iodide, and when sulphurous anhydride was passed into its aqueous solution, and barium hydrate added, a compound of barium opianate and barium sulphite was obtained similar to that formed with aldehyde. Hemipinic acid was undoubtedly the dibasic acid, $C_6H_2(OCH_3)_2(COOH)_2$, corresponding to the monobasic opianic acid. With respect to meconin its

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constitution was not so well made out, but it might be regarded as a kind of lactid. The action of nascent hydrogen on opianic acid first producing a compound $C_6H_2(OCH_3)_2(CH_2OH)(COOH)$, which being unstable lost water and gave meconin, $C_6H_2(OCH_3)_2CH_2.O.CO$.

Dr. Wright replied that he agreed perfectly with Dr. Armstrong; he had for some years past adopted the formulæ given, and believed them to be correct. Great interest would attach to the isolation of opianic acid, &c., from some other of the opium alkaloids, but although he had made many attempts, he had not yet been successful.

Mr. D. Howard said the last remark of Dr. Wright touched on a point of great importance. Might it not be said of many of these substances obtained from opium, are they in opium? or to go farther, are they in the poppy juice? As to how far these changes might take place in the system it would be very inconvenient if, when an anodyne was prescribed, it should be found to become so changed as to produce epileptiform convulsions.

The President having thanked the authors in the name of the Society,

Dr. Armstrong read a "*Note on Isomeric Change in the Phenol Series.*" On heating β dinitro-phenol with bromine and water, bromo-dinitro-phenol melting at 118° was obtained identical with that produced by the action of bromine under similar similar circumstances, on α dinitro-phenol. When β dinitro-phenol is gently heated with bromine and glacial acetic acid, Körner's bromo-dinitro-phenol melting at 75·6° is the sole product, but if the mixture be boiled, a bromo-dinitro-phenol melting at 116° is formed. It appeared, therefore, that the one compound was converted into the other by the action of bromine, or of heat, or by the combined action of both. On trial it was found that the compound melting at 75·6° underwent no change when heated alone to 120°, but with bromine and water at 100° it was entirely converted into the isomeric body of higher melting-point. The action of bromine and water on the dibrom-ortho-nitro-phenol melting at 117°, or on dibromo-para-nitro-phenol melting at 141° yielded a substance insoluble in alkaline solutions and melting above 200°. In a similar manner the action of fuming sulphuric acid and of sulphuric chlorhydrate on dichloro-phenol yielded sulphonic acids which were isomeric and not identical, as the former on nitration gave Stenhouse's chloro-α-dinitro-phenol, whilst the latter yielded dichlor-ortho-nitro-phenol.

The President thanked Dr. Armstrong for his interesting paper, and then adjourned the meeting until Thursday, May 6, for which the following communications are announced:—(1) "On Andrewsite and Chalkosiderite," by Professor N. Story Maskelyne; (2) "Quantitative Separation of Iron Sesquioxide, Alumina, and Phosphoric Acid," by Dr. W. Flight; (3) "On Sodium Ethyl-thiosulphate," by Mr. W. Ramsey; (4) "On a Milligrade Thermometric Scale," by Mr. J. Williams.

Pure Dextrin from Malt.—M. L. Bondonneau.—The author describes the properties of dextrin as formed by the action of diastase. The sample gave no colouration with iodine; with cupric liquid it shows 1·85 per cent of glucose; it is reduced by chloride of gold and ammoniacal nitrate of silver; with baryta water and ammoniacal acetate of lead it gives an abundant precipitate, and is not precipitated by subacetate of lead. The rotatory power of this substance is $aj = 176°$ to the right; that of the pure dextrin obtained by the action of heat is $aj = 186·3°$ to the right.—*Bull. de la Soc. Chim. de Paris.*

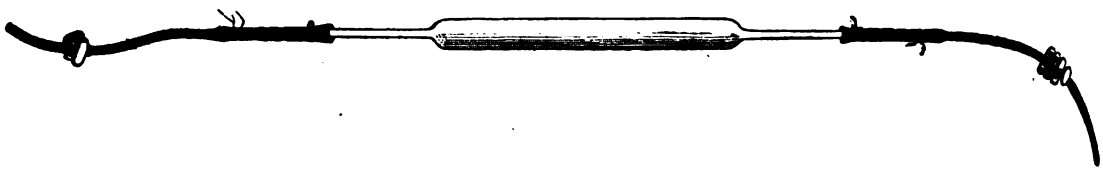
SOCIETY OF PUBLIC ANALYSTS.

NOTE ON TWO NEW FORMS OF TUBES FOR COLLECTING AIR FOR ANALYSIS.

By G. W. WIGNER.

I have had occasion, during the last two years, to make some hundreds of analyses of atmospheric air from factories and other places, and of the gaseous contents of white-lead stacks. The samples have frequently been collected under circumstances which rendered the sealing of glass tubes in the ordinary way peculiarly difficult, and I have therefore adopted two new forms of collecting tubes, which are extremely easy to manipulate. The analyses have all been made by the *McLeod* apparatus, or by a modification of it which I propose to describe at a future time, and the tubes are adapted to facilitate the transfer of the air to the measuring tube of that apparatus.

The first form of tube is that which I use for technical purposes. It consists, as shown in sketch, of a glass tube about 12 inches long over all, in the centre of which a cylindrical bulb has been blown, about 6 inches long and



¼ inch diameter. The tube at the ends has an internal bore of about $\frac{1}{16}$ inch, the total capacity being between 40 and 50 c.c.

On each end of the glass tube a piece of india-rubber tube, about 6 inches long, is securely tied, the glass tube being thoroughly waxed first to ensure a perfect joint. The india-rubber tube used is about ¼ inch bore, and of the best quality procurable, having been made specially for the purpose. On each piece of india-rubber is a Bunsen screw-clamp. I generally fill the tubes by drawing the air into them by means of a small pocket pair of bellows having a tube connected to the *suction* valve, which is joined by a short length of tubing to the sample tube. After drawing air through to the extent of say thirty times the capacity of the tube, the clamps are closed.

I prepare the sample for transfer to the measuring tube of the McLeod apparatus as follows:—Into each of the free ends of the india-rubber tubes I pass a piece of glass tube, about ¼ inch external diameter, with a capillary bore. These tubes are filed to a wedge form (not sharp) at the end which is passed in, and are pushed *close up* to the clamps, and then tied with copper wire. If these precautions are taken it will be found that the amount of *atmospheric* air contained between the pinchcock and the capillary tube, and in the capillary tube itself, will be only a minute fraction (less than 0·02) of a c.c., and even this may be removed and replaced by water if two or three drops are poured into the india-rubber before the glass tube is inserted. One of these capillary tubes is furnished at the outer end with a steel facet, corresponding to the facet on the measuring tube of the gas apparatus. The transfer of the air is then readily effected. The sample tube is placed in a slightly inclined position on the table-stand of the gas apparatus, the facet clamped up to the measuring tube, the other capillary tube immersed in a trough of mercury, and a vacuum produced by lowering the mercury in the measuring tube. It is only necessary to unscrew the clamps and open the stopcock of the measuring tube, and all the air except a small bubble will be transferred. In practice this transference can be easily effected in less than five minutes.

Some doubt was felt at first as to whether the india-rubber tubes would be impervious to the gas, but experi-

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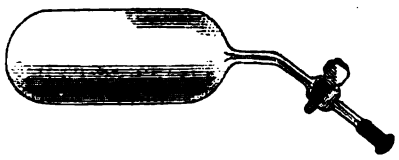
ments on various artificial mixtures, resembling very polluted atmospheric air, have proved that for periods not exceeding three or four days no appreciable change can be detected.

The other form of collecting tube is as follows:—



It consists of a strong cylindrical flask, about 4 inches long and 1¼ inches diameter, with a slightly curved capillary tube as a neck at one end. This capillary tube is fitted with a glass stopcock, and at the end with one of the same steel facets. Its total contents are about 90 or 100 c.c.

For use the air is exhausted from this tube, and the stopcock opened for a few seconds in the place from which the sample has to be taken. The transfer of part of the contents to the McLeod apparatus is of course easily effected, but it is not possible to take all the air unless the Sprengel pump is used for the purpose. I find that I can practically transfer with ease about 70 c.c., which is usually sufficient.

The vacuum may be readily produced in two ways. If the Sprengel pump is in use it will, of course, do it efficiently, but slowly. I prefer, however, the following plan:—I clamp the facet on to a good Tait's air-pump, and exhaust; then unclamp, and immerse the facet in the mercury trough, allowing the mercury to rise into the tube. Of course only a small buhble of air will be left, and, by repeating the exhaustion two or three times, this may be reduced to microscopical dimensions. The tube is then emptied of mercury as follows:—In the table of the McLeod apparatus I have a mercury trough, ½ inch diameter and 3 feet deep. It consists simply of a piece of ½-inch gas-pipe, with a plug at the bottom and a flange at the top, the latter being screwed to the table. A glass tube, of small bore, 3 feet long, and furnished with a stopcock near its upper end, is immersed in this trough, and filled with mercury, so as to form a small barometer tube. A facet at the top of this tube is clamped to the facet of the (mercury filled) collecting tube, and on opening the stopcocks the collecting tube becomes part of the barometer, and the torricellian vacuum is formed in it.

I have not yet met with any foreign stopcocks good enough for such work, but Cetti's stand well. I have tested some selected stopcocks of his make by the torricellian vacuum for three weeks, and been unable to detect any passage of air. The tubes which I have described have also been made by him.

After repeated postponements, the "Sale of Food and Drugs" Bill was partially considered in Committee of the House of Commons on Monday night. Though the number of amendments of which notice had been given was very large, the actual progress made with the Bill was not great.

The first amendment proposed, and which was accepted by the House, was in Clause 2.

As our readers are aware this Bill is "to repeal the Adulteration of Food Acts, and to make better provision for the Sale of Food and Drugs in a pure state."

Its first necessity is, therefore, to define what is to be considered "Food," and what "Drugs." According to the Bill as it stood, "the term *food* shall include every article "used for food or drink by man, other than drugs." It will be seen, by a consideration of this definition, that it might have been so stretched as to include *water*, which has hitherto been considered; and which should be considered as outside any adulteration Act, not being a purchaseable commodity in the same sense as other articles of food and drink. Mr. Spencer-Stanhope proposed that the words "or water" should be inserted after the word "drugs," thus making it clear that "food" should not be considered to include either "drugs" or "water." We thank the hon. member for the West Riding for this very sensible amendment, which, as we have said, the House adopted, as it appears to us only proper that all analyses of water should be paid for as private samples, as they hitherto have been.

When, however, we come to learn the reason which the hon. member gives for proposing his amendment, we are struck with mingled feelings of amazement and amusement. It is "in order to make it clear that water may be analysed under this Act." We should be inclined to doubt the correctness of the report in the *Times*, but that the extraordinary reason given accords exactly with a speech made by Mr. Stanhope (we believe at a meeting of the Farmers' Club) a short time ago.

The hon. member will probably be surprised to learn that the effect of his very excellent amendment will be the exact reverse of what he expected. In Clause 3, two amendments occur. The first is the excision of the word "knowingly" from the first line, the effect of which will be that any person who shall "mix, colour, stain, or powder, any article of food with any ingredient of a nature injurious to health," shall be held, as a matter of course, to have done it knowingly, and be punished accordingly. The other amendment is to substitute for a fixed penalty of £50 for the first offence of knowingly selling an article so "mixed," "coloured," "stained," or "powdered," a fine "not exceeding" £50, thus giving the magistrates power to mitigate the penalty.

Sir Andrew Lusk is the author of this amendment, and there may be good reasons for allowing magistrates a certain amount of discretion, though its result in the working of the present Act has been that (the magisterial mind being variable) a man has been fined as many pounds in one district as he has been shillings in another for precisely the same offence.

Sir Henry Peek supported this amendment on the curious ground that a man might kick his wife to death for less than £50, and therefore argued, we presume, that it was manifestly unfair that he should be mulct in a similar amount for only cheating and half poisoning his neighbour. If Sir Henry Peek considers that a fine of £50 is an adequate punishment for killing a man's wife, he is quite consistent in thinking the amount too heavy for the offence of adulteration; but it certainly is news to us that the crime he mentions can be expiated by the payment of any such sum. In fact, we were simple enough to imagine that, if a man killed his wife, he was guilty either of manslaughter or murder, but we must of course bow to the high authority of Sir Henry Peek, corroborated as it is by the "experience" of Sir Andrew Lusk.

In Clause 4, which forbids the adulteration of drugs with any ingredient *of a nature injurious to health*, the words we have printed in italics are struck out, and in their place, at the suggestion of the President of the Local Government Board, are inserted the words, "so as to injuriously affect the quality or potency of the drug."

This we consider a most decided and marked improvement.

Clause 5, it will be remembered, is qualified by certain "exceptions," one of which is that "any harmless matter may be mixed with an article, for the purpose of rendering it portable, or palatable, or of preserving it, or of improving its appearance;" but to avoid the abuse of this "exception," the words are now added, "unless such matter is used to conceal the inferior quality of the article." For this "amendment," which is also an improvement, we are indebted to Lord Frederick Cavendish.

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It will be seen from the foregoing short review that, of the 33 clauses of the Bill, only the first five have yet undergone manipulation in Committee.

NOTICES OF BOOKS.

Consumption and Tuberculosis; Their Proximate Cause and Specific Treatment by the Hypophosphites. By John Francis Churchill, M.D. London: Longmans, Green, and Co.

As a general rule systems of medical practice can scarcely be deemed to come within our sphere. The author of this work proceeds, however, upon an unusual principle. Instead of, in the ordinary manner, taking in hand some substance whose therapeutic properties happen to be unknown and trying at hap-hazard what it may accomplish in the treatment of different diseases, he endeavours to ascertain by careful research what is the essential feature of tubercular degeneration. Finding evidence that it was due to a "diminution of the phosphorus element in the system," he sought next what compound of phosphorus was best calculated to supply the deficiency, and decided in favour of the hypophosphites. Having thus a theory, he proceeded in due course to the next step, experimental verification. All this we must pronounce to be a strictly logical and legitimate procedure. But what were the results of the verification? Dr. Churchill does not profess that every patient was cured. In some the disease was already so far advanced that recovery was impossible; in others the carelessness of the patient, his manner of life, or the presence of special complications led to a negative result. But in a most decided majority of cases within reasonable limits, the theory proved triumphant, and the patients recovered. Corresponding success has attended this method of treatment in the hands of other physicians, when the conditions laid down by the discoverer were observed, especially when the remedy was genuine, free from phosphites, phosphates, carbonates, &c., and unaccompanied by other medicines which frustrate or modify its action. We learn that sometimes the hyposulphites have actually been sold and used as hypophosphites!

The reception of so important a discovery has not been encouraging. The hypophosphites have been used not according to Dr. Churchill's suggestions, and he has then been blamed for the resulting failures. In other quarters his remedies have been used in secret, and the cures have been attributed to other causes. Conduct of this kind we must admit is not exclusively confined to the medical profession. We have heard of an influential chemist who publicly condemns a certain analytical process, and uses it in private in preference to his own rival method.

The following passage is but too true:—"That in this age of sanitary professors and sanitary humbugs this cause of disease (increased sensitiveness and activity of the nervous system) will attract the attention of those who govern it would be childish to expect or hope. If the means of prevention involved some enormous outlay, requiring some stupendous engineering enterprise, and thus opened a field for some enormous contract . . . no doubt they would attend to it. Perhaps some Government official may be bold enough some centures hence to try the effect of the hypophosphites in promoting the growth and development of military recruits."

Elsewhere we read:—"This is the last ordeal of the inventor before his apotheosis. Among artisans, it is called 'rattening;' in science, it constitutes the well-known process which the French call 'the Conspiracy of Silence.'" What inventor or discoverer cannot confirm this from his own experience? The passages on the treatment of inventors and on the rights of intellectual property deserve to be carefully studied in these days when lawyers and capitalists, eager to protect every other kind of property, are conspiring to rob the patentee and the discoverer.

We hope that all who are interested in Patent Law Reform will read pp. 406—418 of this work, and reflect thereon. It may supply an antidate to the views of Lord Romilly, the Lord Chancellor, and the "Free-stealing" party.

On a Peculiar Fog seen in Iceland, and on Vesicular Vapours. By R. Angus Smith, Ph.D., F.R.S., &c. London: Taylor and Walton.

In this pamphlet, which is reprinted from the fifth volume of the third series of "Memoirs of the Literary and Philosophical Society of Manchester" (Session 1872, 1873), the author gives an account of a remarkable fog observed at Reikjavik, in Iceland. It appears that, on a bright afternoon in July, "as soon as we left the house, a cloud came down a street from southwards, and some one said, 'let us cross out of the way of the dust.' 'I looked more carefully, and finding the cloud moving very slowly on the ground, concluded that it was smoke from a chimney, but smoke mixed with larger particles than we generally see. Gradually it came to us; there was no smell, but a distinct chill.' Perceiving that it was a fog, Dr. Smith ascended a rising ground, and saw the fog rising out of the small lake behind the town, and rolling into the streets very slowly. A similar fog rose from the sea, and rolled also into the town. Hence it appeared that the wind had nothing to do with the matter, but that both fogs rolled because they were too heavy to remain suspended. The peculiarity of the fog was in the size of its particles, larger than any the author had ever before seen, and which he estimates at from $\frac{1}{1000}$th to $\frac{1}{800}$th of an inch in diameter, in the flatness with which it fell on the ground, and in its lumbering mode of rolling, whence all observers at first took it for dust. The author found that the particles where perfectly spherical, and not hollow, but concrete throughout. "They all tended downwards they were falling evidently; it was a falling dew, or a slight incipient rain rapidly disappearing into the earth." Dr. Smith adds: "It seemed evident to me that to make a distinction absolute between fog, rain, and dew, was a waste of words. There is a broad observable distinction, but no narrow line, and we cannot tell the end or beginning of either."

Examining the common opinion of the vesicular nature of clouds and mists, he declares that it "rests on a foundation too weak to be worth much attention. He gives the opinions of some who may be regarded as the best known originators of the vesicular theory, such as Edmund Halley (*Phil. Trans.*, abridged, vol. iii., p. 428). Gottlieb Kratzenstein ("Theorie de l'Elevation des Vapeurs, Bourdeaux, 1743), M. Hamberger, who wrote in the same year, and H. B. de Saussure ("Essais sur l'Hygrometrie," p. 282). None of these meteorologists give any decisive experiments or observations in support of the vesicular theory, but "only a few fancies by no means well supported, even in the opinion of the authors, and still less in that of natural philosophers at the present time." A vague notion that the globules of fog are analogous to soap-bubbles seems to lie at the foundation. Dr. Smith has repeated the experiments of Saussure, but without meeting with any signs of vesicularity. "Indeed," he remarks, in summing up, "I see no reason for going far for a mode of keeping clouds up. Times without number I have observed on calm summer evenings a cloud of smoke from a steamboat funnel lying for miles in length at a height very little different from that of the funnel out of which it issued. . . . At other times I have found the smell of a cigar, used by a person fully a quarter of a mile on, over the road, at about the same height as his mouth, nothing being visible. In these cases, have we anything to look to but the size of the particles? They are so small that their resistance to the atmosphere is diminished to its utmost, as the resist-

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ance of the air is increased so much in proportion to the weight, that they cannot fall rapidly."

Eighth Annual Report of the Warden of the Standards on the Proceedings and Business of the Standards, Weights, and Measures Department of the Board of Trade for 1873-74.

THIS report contains much valuable information, of a nature calculated to interest the commercial as well as the scientific world.

From it we learn that the plan of coating weights with nickel, in order to exclude the action of the atmosphere, cannot be pronounced successful. Three of the larger weights, nickelised in 1872, were found in June, 1874, to have sensibly increased in weight, "tending to show that oxidation is going on under the nickel plating."

It is unsatisfactory to find that "the teaching of the metric system of weights and measures, and the decimal scale in schools, under the authority of the Education Department, "has been formally abandoned by virtue of a notice in the "New Code of Regulations of the Education Department of the Privy Council, issued in 1874." This reactionary step will decidedly retard the much needed reform of our national weights and measures. An attempt made by the Swedish Government to introduce the metric system of weights and measures into the kingdom of Sweden, has been defeated in the Lower Chamber of the Diet by a very large majority.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 11, March 22, 1875.

Examination of the Procedures of the Human Mind in the Investigation of the Unknown by the Aid of Observation and Experiment.—M. Chevreul.—Not adapted for abstraction.

Stability of the Salts of the Fatty Acids in Presence of Water, and on the Reciprocal Displacement of these Acids.—M. Berthelot.—The author finds that the alkaline salts of the fatty acids, in presence of water, behave like compounds intermediate between the salts of the strong acids, which are not appreciably decomposed by water, and the salts of the weak acids (carbonates, borates, &c.), which are partially decomposed by water in the ratio of its quantity, and with a tendency to the simultaneous formation of an acid salt and of free base. This analogy between the fatty acids and the weak acids becomes more striking as their equivalents rise; from formic acid, which is almost as energetic as the powerful mineral acids, to the valerianic, whose neutral salts easily become acid by evaporation; and to the stearic and margaric, whose alkaline salts (soaps) are so readily decomposed by cold water.

Association in the Ural of Native Platinum with Rocks having a Basis of Peridote, and the Relation of Origin which unites this Metal with Chrome Iron.—M. Daubrée.—It is very probable that serpentine was the gangue in which platinum was originally disseminated, at least in the country of Nisché-Tagilsk.

New Electro-Medical Galvanoscope.—M. J. Morin.—The author states that in the therapeutical application of continuous currents the use of the common galvanometer has the inconvenience of requiring preliminary regulation, which requires care and experience on the part of the operator. His new electro-medical instrument is free from this defect.

Theory of Processes for Magnetisation.—M. J. M. Gaugain.—Not suited for abstraction.

Molecular Equilibrium of Solutions of Chrome Alum.—M. Lecoq de Boisbaudran.—A mathematical paper, which requires the accompanying diagram.

Determination of the Boiling-Points of the Chlorinised Derivatives of Toluen.—M. G. Hinrichs.—The same remark applies to this paper.

Bulletin de la Societe Chimique de Paris, No. 3, February 5, 1875.

Saccharo-Carbonate of Lime and Hydrated Carbonate of Lime.—M. L. Bondonneau.—It has been observed long ago that solutions of sucrate of saccharate of lime, treated with carbonate of lime, do not deposit carbonate of lime, but that at a certain point the liquid thickens, and is converted into an opaline mass, decomposable into its elements by excess of carbonic acid and by heat. The mass thus formed has been viewed as a combination of saccharate and of carbonate of lime. The author remarked that the quantity of carbonic acid absorbed to form this magma varied according to the density in solutions of one and the same saccharate. He was hence led to the belief that sugar merely entered into the reaction by means of the increase of density which it occasioned, and that similar thickenings might be obtained with other aqueous solutions; which experience has confirmed in case of gum, dextrin, glycerin, and even of mineral solutions, such as nitrate of soda and chloride of sodium. The thickening is due, not to saccharo-carbonate of lime, but to hydrated gelatinous carbonate of lime.

Cement for Marble and Alabaster.—Mix 12 parts of Portland cement, 6 parts of slaked lime, 6 parts of fine sand, and 1 part of infusorial earth, and make up into a thick paste with silicate of soda. The object to be cemented does not require to be heated. It sets in twenty-four hours, and the fracture cannot be readily found.

Certain New Bleaching Processes.—M. A. Brackebusch.—The methods generally used are not satisfactory, and hence attempts are being made to supersede them. (1) Cotton and linen tissues are brought in contact with oxide of zinc, dissolved in lye of potash or soda. There is no bleaching, properly so-called. The oxide of zinc combining with the textile fibre merely masks the natural colour of the latter. Possibly it may form colourless compounds with the colouring matters present. The alkaline liquids employed may affect the tissues. (2) It has been proposed to bleach wool and silk by immersion for an hour in a solution of 1 part common salt, and 1 part of oxalic acid in 50 of water. The influence of the oxalic acid is certain, though not explained. (3) Tessié du Motay takes about equal parts of permanganate of soda and of sulphate of magnesia, and dissolves them in luke-warm water. The tissues, previously freed from grease, are plunged into this bath till they are covered with a brown coating. They are then placed in a bath of sulphuric acid at 4 per cent, and rinsed after the brown matter is removed. They may be finally passed through sulphurous acid. (4) Ramsay forms his bleaching bath by sprinkling with water equal parts chloride of lime and sulphate of magnesia, when hypochlorite of magnesia is formed. This last process is highly recommendable.

Use of Red Sanders.—Sanders-wood, despite its cheapness, is not much used in dyeing. The red matter is accompanied by a brown colour, which must be completely eliminated—a process not unattended with difficulty. The principles found in sanders are—(1) A bitter, brown extractive matter, sparingly soluble in cold water, but readily soluble at a boil. (2) A red matter, santalin; insoluble in water, soluble in alcohol, strong boiling acetic acid, caustic alkalies, and hot alkaline carbonates. It undergoes a change if exposed to the air in a moist state, and is oxidised, especially in presence of alkalies. (3) Santalidin, one of the oxidation-products of santalin, is less insoluble in water than santalin, but dissolves more freely in the other solvents. The powdered wood, exhausted in boiling water to remove the brown matter, is

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digested in a cold clear solution of chloride of lime as long as it becomes colorless. When this is done, it is carefully washed in cold water, and the dye-bath is prepared. A hot, but not boiling, solution of carbonate of soda is prepared, into which is put the wood contained in a linen bag, and the pan is tightly covered. Heat is applied without bringing it to a boil. When the bath has acquired a bright red colour with a violet tint, it is ready for use. The goods woollen, cotton, or linen, mordanted in an acid bath, are plunged into the sanders beck till they have the wished for shade, and are then returned to the acid beck. Shades are thus obtained not inferior to madder work in brightness and solidity.—*Master Zeitung.*

[We copied this process from the notebook of a friend sixteen years ago, and are therefore much interested to find that it has been re-discovered.]

Liebig's Annalen der Chemie und Pharmacie.
Band 177, Heft 1, Feb. 27, 1875.

Researches from the Laboratory of Prof. F. Beilstein, of Petersburg.—These researches comprise a paper on sulpho-butyric acids, by W. Hemilian; one on the bromine derivatives of ethan, by N. Tawildarow; and a note on the connection of substituted benzols and phenols, by F. Beilstein and A. Kurbatow.

Chlorinised Xylidin obtained from Crystalline Xylol.—Paul Jannasch.—The chlorinised xylidin (para-amido-xylol) is a crystalline base, fusible at 92° to 93°, of faint unpleasant odour, resembling that of toluydin. It is extremely soluble in ether, alcohol, and benzol; scarcely soluble in cold, but moderately so in boiling water, from which it separates in fine foliaceous crystals. It evaporates readily along with watery vapour, and when heated in a hot current of steam it fuses to dull yellow drops. It combines with acids, forming a well-characterised and finely crystalline series of salts, which, however, in consequence of its feeble basic properties, are not very permanent.

Communications from the Laboratory of the University of Erlangen.—Prof. von Gorup Besanez.—These comprise a paper on ratanhin, by Dr. B. Kreitmair; on peucedanin and its products of decomposition, by Dr. Gottlieb Heut, containing an account of the preparation and properties of peucedanin, and its behaviour with potash, with dilute sulphuric acid, with the halogens, and with nitric acid, and an account of oxy-peucedanin; further, a paper on the occurrence of thallium in carnallit, by Dr. F. Hammerbacher. From this it appears that Boettger had already demonstrated the presence of cæsium, rubidium, and thallium in the salts of the Nauheim brine springs. The author, therefore, examined carnallit and other Stassfurt salts containing potash in the same manner. In carnallit he found thallium, rubidium, and cæsium; in sylvin the two latter were recognised, but no thallium; polyhalit and kainit showed no traces of either thallium, rubidium, or cæsium. The Erlangen researches further contain a paper by R. Hornberger, C. Mutschler, and F. Hammerbacher on the ash of the fruits of *Lithospermum officinale*, and the wood of *Calamus rotang* and *Bambusa arundinacea*; and a notice by Prof. von Gorup-Besanez on ditain, a substitute for quinine, recently introduced into commerce, and obtained from *Echitas scolaris*.

Behaviour of the Solutions of Certain Substances with Polarised Light.—O. Hesse.—A long and important paper; not capable of useful abstraction.

Methyl-Aldehyd, and Formic Acid Methylester.—J. Volhard.—The author obtains the former by means of a Davy's lamp fed with methylic alcohol, and the latter by distilling over formiate of lime wood spirit, saturated with hydrochloric acid. The same compound is obtained by decomposing hydrocyanic acid with hydrochlorated wood-spirit.

Determination of the Carbonic Acid in Carbonates.—Julius Hessert.—Persoz proposed to decompose the carbonates by fusion with bichromate of potash, to dry the evolved gas over chloride of calcium, and to receive it in a weighed potash apparatus. The author has examined this process, and finds that, in comparison with Knop's process (*Annalen*, 119, p. 129), it has the disadvantages of being more limited in its applicability, and of requiring a distinct portion of material, but that it has, on the other hand, the advantage of greater simplicity.

Les Mondes, Revue Hebdomadaire des Sciences.
No. 9, March 4, 1875.

In noticing the death of Sir C. Lyell, M. Moigno remarks, "We have found, to our happiness, that in the last edition of this work ("The Antiquity of Man") the arguments which he had previously developed in favour of the indefinite antiquity of man have lost much of their value."

Determination of Glycerin and Succinic Acid in Wines.—M. Maumené.—The author holds that the quantity of these bodies, as produced by the fermentation of glucose simultaneously with alcohol, will be proportionate to the latter, and that the exact knowledge of their amount may thus indicate the quantity of extraneous alcohol added to wine. He prepares hydrated oxide of lead by decomposing a soluble salt of that metal with potash, and after washing it well, suspends it in water. To half a litre of wine, concentrated by evaporation to 335 c.c., he adds oxide of lead enough to cause every trace of colour to disappear. A grey precipitate is formed. Filter, wash the precipitate, and evaporate to dryness in the water-bath. Treat the evaporated residue with absolute alcohol, holding a little hydrated oxide of lead in suspension. Stir, leave the mixture to stand for some hours, and filter. The liquid thus obtained is colourless. If submitted to a current of carbonic acid it grows turbid, but becomes clear again on filtration. It is dried at 110° C., and weighed as pure glycerin. To determine succinic acid, treat a litre of wine with albumen, or raw hide, in sufficient quantity to remove all the tannin. Mix with hydrated oxide of lead (after concentration) till the colour is entirely removed, and preserve the filtrate for the determination of glycerin. The precipitate is kept for a long time in contact with boiling water, containing about 10 per cent of nitrate of ammonia. The clear liquid, obtained on fresh filtration, contains all the succinic acid in the state of succinate of lead, besides other salts of the same base. It is treated with sulphuric (sulphurous?) acid, and filtered again, when we have a perfectly colourless liquid containing free succinic acid. After having heated to expel the excess of sulphuric (sulphurous?) acid, the liquid is concentrated to about 100 c.c., and neutralised with ammonia. Heat sufficiently to expel any excess of ammonia, and add a few drops of ferric chloride, which has been previously kept for a long time in contact with sesquioxide of iron, so as to ensure the absence of free hydrochloric acid. Finally, collect the deposit of succinate of iron which forms, wash it well, ignite, and weigh the residual sesquioxide. This weight, × 1·978, gives the quantity of succinic acid existing in the quantity of wine analysed.

MISCELLANEOUS.

Lectures by Dr. Frankland.—Six lectures by Professor Frankland, on "How to Teach Chemistry," originally delivered to science teachers, will shortly be published by Messrs. Churchill, from notes taken and edited, with Dr. Frankland's sanction, by Mr. George Chaloner, F.C.S.

Metropolitan Gas.—Dr. Letheby, the Chief Gas Examiner under the Board of Trade, has recently reported to the Corporation of the City of London, and to the Metropolitan Board of Works, the results of the daily testings of the gas supplied to London by the Chartered, the Imperial, and the South Metropolitan Gas Companies during the quarter which ended on the 31st of March last.

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At present there are nine testing places where the gas from the several works of these companies are daily tested by the officers appointed by the Corporation and the Metropolitan Board of Works, and the average results of the testings during the quarter have been as follows:—(1) *With respect to Illuminating Power.*—The common gas, when burnt at the rate of 5 cubic feet an hour from a Sugg's London argand burner, No. 1, with a 6-inch chimney, has, in the case of the Chartered Company, averaged the light of 17·37 standard sperm candles at Beckton, 16·86 candles at Friendly Place, Bow, and 16·92 candles at Ladbroke Grove, Notting Hill; while that of the Imperial Company has been equal to 16·17 candles at Carlyle Square, Chelsea, 16·04 candles at Camden Street, Camden Town, 16·93 candles at Graham Road, Dalston, and 16·22 candles at Bruce Terrace, Bromley. The gas of the South Metropolitan Company at Hill Street, Peckham, has been 15·94 standard sperm candles; and the cannel gas of the Chartered Company at Millbank Street, Westminster, has, with a Sugg's steatite bats'-wing burner, No. 7, burning at the rate of 5 feet an hour, given the light of 20·94 standard sperm candles. These results show that the illuminating power of the gas at each of the testing places has been fully equal to the requirements of the Acts of Parliament by which the companies are regulated. (2) *As regards Purity.*—The gas of all the companies has been constantly free from sulphuretted hydrogen, and the average amounts of sulphur in other form than this have been as follows:—In the Chartered gas—At Beckton, 10·97 grains per 100 cubic feet of gas; at Friendly Place, 13·18 grains; at Ladbroke Grove, 19·40 grains; at Millbank, 17·63 grains. In the gas of the Imperial Company, the proportions of sulphur have been 17·49 grains per 100 feet at Carlyle Square, 15·10 grains at Camden Street, 16·18 at Graham Road, and 10·89 grains at Bruce Terrace; while that of the South Metropolitan Company has been 18·33 grains per 100 feet. Dr. Letheby reports that the proportion of sulphur in the gas has exceeded the prescribed quantity on four occasions at Ladbroke Grove, on four occasions at Bruce Terrace, and on three occasions at Hill Street, Peckham. The excess at Bruce Terrace is reported to have resulted from accidental and unavoidable causes. Ammonia has been at all times absent from the gas of the Imperial Company at Bruce Terrace, Bromley; and the maximum amount in the same Company's gas at Graham Road, Dalston, was only 2-10ths of a grain per 100 cubic feet. At Carlyle Square it was 0·7 of a grain, and at Camden Street 1·5 grains. In the Chartered Company's gas, the maximum amount at Ladbroke Grove was only 0·4 of a grain per 100 feet; at Millbank, 0·5 of a grain; at Friendly Place, 2 grains; and at Beckton, 3·8 grains. On two occasions, the ammonia in the gas at the last-named testing place exceeded the prescribed quantity of 2·5 grains per 100 cubic feet. The maximum amount of ammonia in the gas of the South Metropolitan Company was 1·6 grains per 100 feet.

MEETINGS FOR THE WEEK.

MONDAY, 26th.—Medical, 8
—— London Institution, 8.
—— Geographical, 8.30.
—— Birkbeck Scientific Society, 8. Mr. R. G. Madden, "On the Chemistry of Dyeing."
TUESDAY 27th.—Civil Engineers, 8.
—— Anthropological, 8.
—— Royal Institution, 3. Prof. Duncan, "On the Grander Phenomena of Physical Geography."
WEDNESDAY, 28th.—Society of Arts, 8.
—— Geological, 8.
—— London Institution, 12. (Anniversary.)
THURSDAY, 29th.—Royal Institution, 3. Prof. Seeley, "On the Fossil Forms of Flying Animals."
—— Royal Society Club, 6.30.
—— Royal, 8.30.
—— Zoological, 1. Anniversary.
FRIDAY, 30th.—Royal Institution, Weekly Evening Meeting, 8. Mr. W. N. Hartley, "Action of Heat upon Coloured Liquids," 9.
SATURDAY May 1st.—Royal Institution, 2. Annual Meeting.

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THE CHEMICAL NEWS.

Vol. XXXI. No. 805.

ON ATTRACTION AND REPULSION RESULTING FROM RADIATION.*

By WILLIAM CROOKES, F.R.S., &c.

Part II.

This is the second part of a paper which the author sent to the Royal Society in August, 1873. The author commences by describing improvements which he has made in the Sprengel pump, and in various accessories which are necessary when working at the highest rarefactions.

Continuing the description of apparatus, the author describes different new forms which enable the phenomena of repulsion by radiation to be observed and illustrated. A bulb 3 inches diameter is blown at the end of a glass tube 18 inches long. In this bulb a fine glass stem, with a sphere or disk of pith, &c., at each end is suspended by means of a cocoon fibre. The whole is attached to the Sprengel pump in such a way that it can be perfectly exhausted, and then hermetically sealed. Besides pith, the terminals may be made of cork, ivory, metal, or other substance. During exhaustion several precautions have to be taken, which are fully entered into in the paper. To get the greatest delicacy in an apparatus of this kind, there is required large surface with a minimum of weight. An apparatus constructed with the proper precautions is so sensitive to heat that a touch with the finger on a part of the globe near one extremity of the pith will drive the index round over 90°, whilst it follows a piece of ice as a needle follows a magnet. With a large bulb, very well exhausted, and containing a suspended bar of pith, a somewhat striking effect is produced when a lighted candle is placed about 2 inches from the globe. The pith-bar commences to oscillate to and fro, the swing gradually increasing in amplitude until the dead centre is passed over, when several complete revolutions are made. The torsion of the suspending fibre now offers resistance to the revolutions, and the bar commences to turn in the opposite direction. This movement is kept up with great energy and regularity as long as the candle burns.

The author discusses the action of ice, or a cold substance, on the suspended index. Cold being simply negative heat, it is not at first sight obvious how it can produce the opposite effect to heat. The author, however, explains this by the law of exchanges, and shows that attraction by a cold body is really repulsion by radiation falling on the opposite side. According to the same law, it is not difficult to foresee what will be the action of two bodies, each free to move, if they are brought near to one another in space, and if they differ in temperature either from each other or from the limiting walls of the space. The author gives four typical cases, with experiments, which prove his reasoning to be correct.

Experiments are described with the object of ascertaining whether the attraction by heat, which, commencing at the neutral point, increases with the density of the enclosed air, will be continued in the same ratio if the apparatus is filled with air above the atmospheric pressure. This is found to be the case.

Various experiments are described with bulb-apparatus, in which the bulb is surrounded with a shell containing various adiathermous liquids, and also with a shell of vacuum. In all cases radiation passed through, producing the normal action of attraction in air and repulsion in a vacuum.

The author next describes a form of apparatus by which measurable results are attainable. It consists of a long glass tube, with a wider piece at the end. In it is suspended a lump of magnesium by a very fine platinum wire, the distance between the point of suspension and the centre of gravity of the magnesium bob being 39·14 inches. Near the magnesium is a platinum spiral, capable of being ignited by a voltaic battery. Observations of the movement of the pendulum are made with a telescope with micrometer eyepiece. With this apparatus a large series of experiments are described, starting from air of normal density, and working at intermediate pressures up to the best attainable vacuum. The results are given in two tables.

With this apparatus it was found that a candle-flame brought within a few inches of the magnesium weight, or its image focused on the weight, and alternately obscured and exposed by a piece of card at intervals of one second, will soon set the pendulum in vibration when the vacuum is very good. A ray of sunlight allowed to fall once on the pendulum will immediately set it swinging.

The form of apparatus is next described which the author has finally adopted, as combining the greatest delicacy with facility of obtaining accurate observations, and therefore of getting quantitative as well as qualitative results. It consists of a glass apparatus in the shape of an inverted T, and containing a horizontal glass beam suspended by a very fine glass thread. At the extremities of the beam are attached the substances to be experimented on, and at the centre of the beam is a small mirror from which a ray of light is reflected on to a graduated scale. The advantage which a glass thread possesses over a cocoon fibre is that the index always comes accurately back to zero. In order to keep the luminous index at zero, except when experiments are being tried, extreme precautions must be taken to keep all extraneous radiation from acting on the torsion-balance. The whole apparatus is closely packed all round with a layer of cotton-wool about 6 inches thick, and outside this is arranged a double row of Winchester quart bottles filled with water, spaces only being left for the radiation to fall on the balance, and for the index ray of light to get to the mirror.

However much the results may vary when the vacuum is imperfect, with an apparatus of this kind they always agree among themselves when the residual gas is reduced to the minimum possible; and it is of no consequence what this residual gas is. Thus, starting with the apparatus full of various vapours and gases, such as air, carbonic acid, water, iodine, hydrogen, ammonia, &c., at the highest rarefaction there is not found any difference in the results which can be traced to the residual gas. A hydrogen-vacuum appears the same as a water- or an iodine-vacuum.

With this apparatus the effect of exposing a torsion-balance to a continuous radiation is described, and the results are shown graphically. The effect of a short (11·3 seconds) exposure to radiation is next described, and the results are given in the form of a table.

In another table is given the results of experiments in which a constant source of radiation was allowed to act upon one end of the torsion-beam at a distance of 140 or 280 millims., various substances being interposed. The sensitiveness of this apparatus to heat-rays appears to be greater than that of an ordinary thermo-multiplier. Thus the obscure heat-rays from copper at 100°, passing through glass, produce a deflection on the scale of 3·25, whilst under the same circumstances no current is detected in the thermo-pile. The following substances are used as screens, and the deflections produced, when the source of radiation is magnesium wire, a standard candle, copper at 400°, and copper at 100°, are tabulated:—

Rock-salt, 20 millims. thick; rock-crystal, 42 millims. thick; dark smoky talc; plate glass of various thicknesses, both white and green; a glass cell containing 8 millim of water; a plate of alum 5 millims. thick; calc-spar

* Abstract of a Paper read before the Royal Society, April 27, 1875.

millims. thick; ammonio-sulphate of copper, opaque to rays below F; ditto, opaque to rays below G.

The author considers that these experiments show that the repulsion is not entirely due to the rays usually called heat, *i.e.*, to the extreme- and ultra-red of the spectrum. Experiments have been tried with the electric and the solar spectrum formed with a quartz train, which prove the action to be also exerted by the luminous and ultra-violet rays. Some numerical data have been obtained, but unfavourable weather has prevented many observations being made with the solar spectrum.

The barometric position of the neutral point dividing attraction from repulsion is next discussed. The position of this point varies with the density of the substance on which radiation falls, the ratio of its mass to its surface, its radiating and conducting-power for heat, the physical condition of its surface, the kind of gas filling the apparatus, the intensity of radiation, and the temperature of the surrounding atmosphere. The author is inclined to believe that the true action of radiation is repulsion at any pressure, and that the attraction observed when the rarefaction is below the neutral point is caused by some modifying circumstances connected with the surrounding gas, but not being of the nature of air-currents.

The neutral point for a thin surface of pith being low, and that for a moderately thick piece of platinum being high, it follows that at a rarefaction intermediate between these two points pith will be repelled, and that platinum will be attracted by the same beam of radiation. This is proved experimentally; and an apparatus showing simultaneous attraction and repulsion by the same ray of light is described and illustrated in the paper.

The paper concludes with a discussion of the various theories which have been adduced in explanation of these phenomena. The air-current and electrical theory are considered to have been abundantly disproved. The following experiment is given by the author to show that Prof. Osborne Reynolds's hypothesis of the movements due to evaporation and condensation at the surface will not account for all the facts of the case, and that, therefore, he has not hit upon the true explanation. A thick and strong bulb was blown at the end of a piece of very difficultly fusible green glass, specially made for steam-boiler gauges. In it was supported a thin bar of aluminium at the end of a long platinum wire. The upper end of the wire was passed through the top of the tube and well sealed in, for electrical purposes. The apparatus was sealed by fusion to the Sprengel pump, and exhaustion was kept going on for two days, until an induction-spark refused to pass across the vacuum. During this time the bulb and its contents were several times raised to a dull red heat. At the end of two days' exhaustion the tube was found to behave in the same manner as, but in a stronger degree than, it would in a less perfectly exhausted apparatus, viz., it was repelled by heat of low intensity and attracted by cold. A similar experiment was next tried, only water was placed in the bulb before exhaustion. The water was then boiled away *in vacuo*, and the exhaustion continued, with frequent heating of the apparatus to dull redness, for about forty-eight hours. At the end of this time the bar of aluminium was found to behave exactly the same as the one in the former experiment, being repelled by radiation.

It is impossible to conceive that in these experiments sufficient condensable gas or vapour was present to produce the effects Prof. Osborne Reynolds ascribes to it. After the repeated heating to redness at the highest attainable exhaustion, it is impossible that sufficient vapour or gas should condense on the movable index to be instantly driven off by the warmth of the finger with recoil enough to drive backwards a heavy piece of metal.

While objecting to the theories already advanced as not accounting for all the facts of the case, the author confesses that he is not as yet prepared with one to put in their place. He wishes to avoid giving any theory on the subject until a sufficient number of facts have been accumulated. The facts will then tell their own tale. The conditions under which they invariably occur will give the laws, and the theory will follow without much difficulty.

Since the experiments mentioned in the foregoing abstract were concluded, the author has examined more fully the action of radiation on black and white surfaces. At the highest exhaustion heat appears to act almost equally on white and on lampblack pith, repelling them in about the same degree.

The action of the luminous rays is, however, different. These repel the black surface more energetically than they do the white surface. Taking advantage of this fact, the author has constructed an instrument which he calls a radiometer. This consists of four arms, suspended on a steel point resting on a cup, so that it is capable of revolving horizontally. To the extremity of each arm is fastened a thin disk of pith, lampblacked on one side, the black surfaces facing the same way. The whole is enclosed in a glass globe, which is then exhausted to the highest attainable point and hermetically sealed.

The author finds that this instrument revolves under the influence of radiation, the rapidity of revolution being in proportion to the intensity of the incident rays.

Several radiometers, of various constructions as regards details, but all depending on the above-named discovery, were exhibited by the author at the Soirée of the Royal Society on the 7th inst., and numerous experiments were shown with them. The following table which gives the result of some experiments tried with one of the first-made radiometers (and therefore not so sensitive as more recent instruments), is copied from a card which was distributed during the evening:—

TIME REQUIRED FOR ONE REVOLUTION.

Source of Radiation.	Time in Seconds.
1 candle, 20 inches off	182
" " 10 " "	45
" " 5 " "	11
2 candles, " " "	5
4 " " " "	3
8 " " " "	1·6
1 candle, " " " behind green glass	40
" " " " " " blue "	38
" " " " " " purple "	28
" " " " " " orange "	26
" " " " " " yellow "	21
" " " " " " light red "	20
Diffused daylight, dull	2·3
" bright	1·7
Full sunshine, 10 A.M.	0·3
" " 2 P.M.	0·25

These experiments are not mentioned in the paper of which the above is an abstract, as it is intended to make the radiometer the subject of a future communication to the Society.

ON THE ANALYSIS OF CRUDE ANTHRACEN.

By GEORGE E. DAVIS and T. H. DAVIS.

(Concluded from page 180.)

IN Lück's method, the crude anthracen is dissolved in glacial acetic acid and oxidised with a large excess of an acetic acid solution of chromic acid. The anthrachinon formed cannot by this means be further oxidised; but how do the other constituents of crude anthracen act under this treatment? Crude anthracen may be supposed to contain, beside the easily expressible oil:—

1. Naphthalen, $C_{10}H_8$.
2. Acenaphthen, $C_{12}H_{10}$.
3. Fluoren, (?).
4. Phenanthren, $C_{14}H_{10}$.
5. Anthracen, $C_{14}H_{10}$.
6. Pyren, $C_{16}H_{10}$.
7. Chrysen, $C_{18}H_{12}$.

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8. Reten, $C_{18}H_{18}$.
9. Benzerythren, (?).
10. Chrysogen, (?).

Now, the first, or naphthalen, is easily oxidised to naphthachinon, and thence to phthalic acid, and if any trace of this acid should remain mixed with the anthrachinon, it will be washed out by the dilute alkali used in the after process.

The next, or acenaphthen, is converted by the aceto-chromic acid into naphthalic or naphtho-phthalic acid, the sodium salt of which is easily soluble in water. Acenaphthen is, therefore, easily eliminated.

Of the third, or fluoren, very little is known; but, as it is associated with acenaphthen, and melting at a little over 100° C., we have every reason for believing that it is eliminated in the process of oxidation.

The fourth, or phenanthren, the isomer of anthracen, is oxidised by chromic acid in acetic acid solution to phenanthrachinon, and this rapidly, after which a slow oxidation sets in, and the phenanthrachinon is oxidised to diphenic acid, a body having the same percentage composition as alizarin, and soluble in dilute alkali.

On anthracen it is needless to dilate. It is oxidised to anthrachinon, and there the oxidation stops, and the product is insoluble in dilute alkali.

The sixth on the list is pyren. This hydrocarbon is acted upon by aceto-chromic acid very energetically, with the formation of pyrochinon, and this is acted upon by an excess of chromic acid, and, according to R. Lucas (CHEMICAL NEWS, vol. xxx., p. 190), is converted into a substance soluble in dilute alkali.

The seventh, chrysen, is converted, by oxidation, into chrysochinon, and then, by prolonged digestion, Lucas states that, with a large excess of chromic acid, the product is soluble in dilute alkali. That this is the case we have inferred from some of our own experiments; but with chrysen there sometimes exists another hydrocarbon, possessing a much higher melting-point: this is obtained during the coking of pitch, and we here express a doubt whether this hydrocarbon is capable of being oxidised by chromic acid in acetic acid solution, at least in any ordinary length of time.

Number eight is reten. This polymer of acetylene, when heated with aceto-chromic acid, splits up; a lower carbon compound is formed, dioxyretisten, $C_{16}H_{14}O_2$, and the solution yielding phthalic anhydride. Dioxyretisten is a brick-red powder, which crystallises from alcohol in long flat orange-coloured needles, but very slightly attacked by aceto-chromic acid, and insoluble in dilute soda solution. By giving the chromic acid a long time to act, and using it in large excess, we believe that dioxyretisten may be further oxidised and rendered soluble in dilute alkali; but we have no experiments made upon absolutely pure reten, and we argue from this standpoint that, with sufficient time, and with a large excess of chromic acid, our weighed anthrachinons possessed only the pale yellow colour characteristic of anthrachinon, and did not give us any reddish coloured residue, even when crude anthracen was operated upon, which we knew, from the conditions of manufacture, ought to have contained reten.

Number nine, or benzerythren, has been ascertained by Lucas to be oxidised to a product soluble in dilute alkali. Very little is known about benzerythren and its oxidation, but it is very probable, by the experiments of Lucas, that it in no way interferes with the application of Lück's method of analysis to crude anthracen.

In number ten we have chrysogen, which is contained in much larger quantities in some parcels of crude anthracen than in others. It is entirely converted into products soluble in weak caustic soda solution; not a trace remains unoxidised.

In some samples of crude anthracen there exists a dark green hydrocarbon, which is much less soluble in glacial acetic acid than the other constituents of the crude article. This hydrocarbon fuses at 271° C., and is a most difficult substance to oxidise when not thoroughly in solution; in solution, even, it is very obstinate, and resists oxidation for a long time. Fortunately, this hydrocarbon does not occur frequently, and its presence is easily detected.

In order to thoroughly test Lück's anthrachinon method, we saw it was first necessary to prepare pure anthracen, an operation in which we foresaw no small difficulty, and fully experienced it.

After getting rid of the more fusible oils from the crude anthracen and some of the higher fusing ones, the product was boiled with alcoholic picric acid; but, as this method would not give us absolutely pure anthracen, it was abandoned, and we failed to get pure anthracen by this method, because acenaphthen, chrysen, and probably benzerythren form also crystalline compounds with picric acid.

From some samples of crude anthracen it is next to impossible to prepare the pure article, and, after spending nearly two months on a particular sample, we were obliged to give the experiments up and commence working on a new parcel, from which we had very little difficulty in preparing pure anthracen.

The sample upon which we worked showed 56·0 per cent of anthracen by the bisulphide method and 39·016 per cent by the anthrachinon method, the parcel being actually sold on a 56 per cent basis. This was the parcel we abandoned, and worked instead upon one which contained 41·088 per cent of real anthracen, and nearly 60 per cent by the bisulphide method.

A large quantity of this anthracen was taken and digested for three hours with carbon disulphide, in proportion rather less than in a "bisulphide" analysis, filtered off by the aid of the Bunsen pump, and washed with carbon disulphide upon the filter until the filtrate came away colourless; the action of the pump was then kept on to dry the mass. The filtrate, when evaporated to dryness at the temperature of the air and fused at 100° C., contained 14·021 per cent of real anthracen, showing that more impurities were dissolved out than in an actual bisulphide analysis. The residue upon the filter should then contain more real anthracen; it did, containing 70·192 per cent. This bisulphide residue was warmed to 30° C. with light petroleum oil, and filtered warm; the filtrate came through at first brownish yellow, and when cooled deposited a little anthracen coloured by chrysogen. The residue on the filter was washed with petroleum until the washings came away colourless, and well dried by means of the pump. This residue was then warmed with ether, filtered, and washed on the filter with warm ether until the ether ran through colourless.

This ether solution was placed in a retort, and the ether three-fourths distilled off, the remainder being evaporated on the water-bath, which left a white fatty-looking residue containing 9·039 per cent of real anthracen. The residue from the ether washing was boiled with alcohol in large excess and filtered; the residue was of a very green colour, and contained 82·176 per cent of real anthracen.

This residue was then mixed with some other alcohol, bisulphide, and ether residues containing from 80 to 90 per cent of real anthracen, and well washed with carbon disulphide and then with ether. The residue, after being well dried, contained 90 per cent of anthracen.

This 90 per cent substance was then cautiously sublimed, whereby the green colouring matter became carbonised, and also most of the chrysogen, and the sublimate, after being washed with ether and warm alcohol, contained 97·875 per cent of anthracen. This was taken and dissolved in a slight excess of boiling alcohol, filtered boiling hot, and allowed to crystallise. The crystals were washed with cold alcohol, and dried at 100° C. Three analyses were made, as follows:—

	Pure Anthracen. Per cent.
1.	99·124
2.	99·506
3.	99·477
Average	99·369

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The fusing-point of this sample was made by us as follows:—

	°C.		
1.	212·5	T. H. D.	With small sulphuric acid bath.
2.	212·0	T. H. D.	
3.	212·8	G. E. D.	With very large paraffin bath slowly heated.
4.	212·8	G. E. D.	

In the third and fourth experiments, the anthracen was placed between two small thin glass test-tubes, one inside the other and nearly touching, to secure actual contact of the anthracen with the glass, and to ensure no appreciable thickness of non-conducting material, and to make everything more uniform, the inner test-tube was partly filled with mercury.

Some of this anthracen was sealed up in air in small tubes, and exposed in the lower half of the tubes to the heat of a water-bath. A very slight sublimation was obtained in four hours, and the crystals in every case did not assume any *regular* crystalline form. Some was then sealed up in a Sprengel vacuum, and, after an hour's heating at 100° C., well-defined six-sided plates were obtained, mixed, however, with many ill-defined crystals; and it may be interesting to remark that the anthracen (sublimed), containing less than 99·3 per cent of anthracen by the anthrachinon method, gave quantities of four- and five-sided tables, which were not to be found in the 99·3 per cent sample.

In order further to try the process, we made the following experiments:—

We first examined six samples of crude anthracen, with the following results:—

No. of Sample.	Anthracen by Anthrachinon. Per cent.
1.	19·842
2.	23·020
3.	41·477
4.	39·444
5.	14·021
6.	9·039

(α). A mixture was made of 1 grm. of each of the above. Two analyses were made of the mixture:—

	Anthracen. Per cent.
1.	24·166
2.	24·210

The arithmetic mean of the mixture would be 24·474.

(β). Two grms. of No. 3 were mixed with 3 grms. of No. 5, and the mixture gave as under:—

	Anthracen. Per cent.
1.	25·333
2.	25·279

The mean of the mixture should have been 25·003.

(γ). One grm. of No. 4 was mixed with 4 grms. of No. 6, when the following results were obtained:—

	Anthracen. Per cent.
1.	15·000
2.	14·876

The mean of the mixture being 15·120 per cent.

(δ). Half a gramme of No. 4 was mixed with 0·5 grm. of the pure anthracen, and when examined gave 70·0 per cent, instead of 69·722, the mean.

As to several good analysts working by the anthrachinon method upon the same sample, we give the following results, calling the analysts A, B, and C. They were 100 miles apart, working with their own reagents in different laboratories.

	A.	B.	C.
1.	31·17	31·64	—
2.	30·87	31·18	—
3.	—	65·05	65·03
4.	—	38·91	39·44

We have now shown that, if the process is properly worked, it will give accurate and reliable results perfectly uniform in themselves. We must now consider how the process is to be properly worked, and give a few instances of departures from the general method.

To work the process, are required the following reagents and apparatus:—

(1). Glacial acetic acid; and care should be taken that it is the strongest acid procurable.

(2). Chromic acid. This may be readily obtained in large, pure crystals; should, however, it be found difficult to obtain, the method of preparing it, as given in Thorpe's "Quantitative Analysis," p. 236, may be employed. The chromic acid must be free from lead-salts, and, in fact, from any trace of any insoluble impurity.

The oxidation should be performed in a flask of 200 c.c. capacity; this should be fitted with a caoutchouc stopper having two holes, into one of which is inserted a pipette furnished with a stop-cock, and into the other a glass tube 3 feet in length, 5 m.m. internal bore at bottom, where it enters the cork, and 10 m.m. at the top.

This tube acts as a condenser, and prevents any rapid loss of acetic acid in the process. We at first used open flasks, adding fresh acetic acid as the original quantity evaporated; then we adopted the double perforated cork, containing a pipette and a tube 1 foot in length, and still there was a large loss of acetic acid. Mr. Lucas's practice is to use a tube 3 feet in length, and we have found that with such a length there is very little loss through volatilisation, and an oxidation can go on by its use without much attention from the operator.

We have used the Bunsen pump as an aid to filtering, but only in that it became the means of shortening the time spent on an analysis, washing the anthrachinon much quicker and with much less fluid than the ordinary way, and facilitating the drying.

The Process.—This has been described before, but no special precautions have been mentioned, therefore we do not think it out of place to describe exactly how we operate. The crude substance is well broken up to powder, well mixed, and a fair average sample taken. Some crude parcels can be well sampled, especially if steam-pressed, and the crystallised article can be easily sampled, as the particles do not cohere, as in the case with very low strength and greasy samples, which require more care to sample fairly.

One gramme of this sample is taken and placed in the 200 c.c. flask; 50 c.c. of glacial acetic acid are then added, and the flask closed with the cork and tubes. This is placed upon a hot plate until the crude substance has all dissolved. Should any insoluble matter be left behind, a longer digestion may be given, and should any residue remain, the contents of the flask must be filtered boiling, and the filter washed with boiling glacial acetic acid. The pipette is then to be filled with 15 grms. of chromic acid in 2 c.c. of water and 10 c.c. of glacial acetic acid, and while the solution in the flask is boiling, the chromic acid is to be admitted drop by drop. High percentages of anthracen will take much less than 15 grms., but it is always well to add a large excess, as it will probably save going over the analysis again.

The flask is kept boiling on the hot-plate for at last three hours (Lucas), and in some cases four hours will be required. We think that, where occasional samples only are done, that it would be as well to give all four hours, for there is no inconvenience attached to such a digestion; the only attention a sample requires is in the first half hour, when running in the chromic acid.

After being sufficiently oxidised, which nearly every sample will be in four hours, the flask is cooled and diluted to 200 c.c. After standing all night, the contents of the flask are poured through a filter, preferably Swedish, and well washed with water. After washing with water, it is next washed with a dilute solution of sodium hydrate, sp. gr. 1·04, and then again thoroughly washed with water. The pure anthrachinon is then dried at 100° C., and weighed; 0·01 grm. is then to be added for the solubility of the chinon in acetic acid, and the weight obtained multiplied by the factor 0·8556 to reduce it to anthracen.

Some have objected to this process on account of the addition of 0·01 for solubility; for our own part, we do not see why such an addition should not take place, the more especially when the solubility of anthrachinon in acetic acid is such a definite and constant quantity. Our own determinations, both in pure acetic acid and in the filtrates from anthrachinons, only prove Lück's figures, 0·009 in pure acetic acid, and 0·01 in the same acid mixed with the acid products of the oxidation of crude anthracen.

The filters used in the process should, before weighing, be washed first with acetic acid, next with water, thirdly with sodium hydrate, and lastly with water again, and finally dried at 100° C. This brings them into the same condition as after the filtration of the chinon, and no error is introduced here.

The anthrachinon must be of a uniform very pale yellow colour. Should it be in any way orange, owing to the presence of phenanthrachinon, it is the better plan to reject the experiment and commence again, giving a much longer oxidation, when the yellow anthrachinon will most probably be obtained.

Whatever may be the composition of the green hydrocarbon with such a high melting-point (about 271° C.), it certainly is not oxidised by chromic acid. Fortunately, it is not very soluble in acetic acid, and it may, therefore, for the most part, be separated by filtration; and it is only in a few samples that this compound has been discovered.

We now give a few results comparing the three processes side by side, when the enormous variations may be readily seen:—

No.	Alcohol, 0·830.	Carbón Disulphide.	Anthrachinon.
1.	37·782	26·375	27·810
2.	56·120	42·200	34·880
3.	43·000	33·460	28·200
4.	36·450	22·000	23·300
5.	37·340	23·500	24·000
6.	36·730	23·300	23·950
7.	35·620	19·900	22·500
8.	38·740	25·900	24·950
9.	39·150	29·400	26·200
10.	52·800	40·500	32·940
11.	73·000	56·600	39·444
12.	71·452	56·400	39·016

With this we conclude, hoping that those chemists and operators working at this subject may find something useful and interesting, even if not novel to many. What we have principally aimed at was, to get an anthracen showing near 100 per cent by the anthrachinon test of Lück, and exhibiting the same crystalline structure when sublimed at low temperatures. This we have done, and now rest satisfied that the anthrachinon method, in spite of all that has been said against it, may be relied on.

APPARATUS FOR OBTAINING SULPHURETTED HYDROGEN.

By SERGIUS KERN, St. Petersburg.

For the purpose of obtaining this gas very complicated apparatus are in use in laboratories, Kipp's apparatus being generally preferred.

I offer, a simple apparatus, very suitable, especially for mining explorations, when, as is generally the case, only a box with a few reagents and apparatus happens to be at hand. A glass tube 0·2 metre long, and 0·05 metre diameter, is closed at the lower end by means of a cork covered with melted wax. Then nearly the half of the tube is filled with diluted sulphuric acid, and a cork, also covered with wax, 0·005 metre thick, with small holes the size of a thick pin, is introduced into the tube to the middle of it. On the top of this cork small pieces of ferrous sulphide (FeS) are placed. Next, the upper part of the tubed is corked. Through this cork passes a bent glass tube fitted with a gutta-percha one with a Moor's screw. For receiving a jet of sulphuretted hydrogen, the screw is opened, and the tube is inclined in such a manner as to bring the acid solution in contact with the ferrous sulphide.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

April 24th, 1875.

W. SPOTTISWOODE, LL.D., F.R.S., in the Chair.

Mr. J. BARRETT exhibited an "auxiliary air pump" which is a modification of Poggendorff's arrangement for obtaining a Torricellian vacuum, and is also allied in principle to the exhauster used by Geissler in the preparation of vacuum tubes. The following is a description of the instrument, but it is difficult to explain its action without the aid of a diagram:—A cylindrical glass vessel containing about 60 lbs. of mercury, is connected by a glass tube ¾ of an inch in diameter, with another similar vessel, which is placed about 18 inches above it. The upper vessel is divided near the top into two parts, which are connected by a short neck. The tube communicating with the receiver passes into this vessel, and is alternately opened and closed below the neck as the mercury rises and falls by a floating valve. This upper vessel is in permanent connection with a glass vessel at the back of the instrument, which is rendered vacuous in the ordinary way, and the mercury keeps its place in the upper vessel until the lower one is rendered vacuous by the air pump. A platinum valve in the back of the upper vessel retains a certain quantity of mercury, when the bulk of the mercury (with which the whole vessel is filled at the commencement of operations) falls by its weight into the lower vessel, which, as has been stated, is rendered vacuous by the air pump. The interval between the two volumes of mercury is a Torricellian vacuum, into which the residual air flows, through the floating valve, which again closes as the mercury rises in the upper vessel and forces through the platinum valve, and upper column of mercury, the air which has entered from the receiver. It is possible to obtain a very good vacuum in a large receiver by the aid of this instrument.

Mr. BARRETT also showed a hammer break for the instantaneous rupture of the current in the primary wire of an induction coil. It is impossible to explain it clearly without a diagram, but an upright swing hammer is kept constantly vibrating by the alternate action of a spring and the magnetic break.

Dr. W. H. STONE read a paper "*On some Points Connected with Wind Instruments.*" He stated that discrepancies might be noted in the behaviour of air issuing from the side orifices of wind instruments. These discrepancies deserve attention, and may be accounted for by the laws of efflux. He showed that the stream of air from the side hole of a clarinet was sufficient to extinguish a candle, though the musical vibration was obviously in the main tube. It is usual to tune such instruments by introducing a resinous cement into the holes so as to diminish their calibre, but after a certain point is reached the rounded surface thus obtained ceases to produce an effect. If a short pipe of the same diameter as the orifice be now inserted, auxiliary vibrations are set up, and a definite note may be produced. Dr. Stone was led to enquire whether the theorem of D. Bernoulli, or the particular case of it named after Torricelli, could be brought to bear on the question. The *vena contracta*, which in fluids reduces the efflux to 0·62 of the calculated amount, is also to be noticed in gases, and the nature of the effluent column of air is affected by three conditions:—(1) The thickness of the wall in which the orifice is made; (2) the shape of the

nozzle; (3) friction in a long pipe. Some mathematical details were then given respecting these conditions, and it was admitted that the vibration in a musical tube must also exercise sensible influence. There are two functions in a side orifice in an instrument; the first is to cut off a portion of the tube, and by this means to raise the pitch; the second establishes a point of non-resistance in the wall of the tube, and thus acts by influencing the longitudinal vibrations. In the organ, peculiar qualities of tone are often obtained by these side holes, as in the "viol-di-gamba" and "keraulophon" stops. In flutes, oboes, clarinets, and other instruments, much of the tone comes from the bell, even when the side holes are open. In instruments in which the holes are long, as in the bassoon, the holes themselves become separate vibrating tubes. This was shown by introducing tubes of different and increasing lengths into an orifice in the side of an organ reed-pipe. The friction at last became so great, and the secondary wave so strong, that the organ-pipe returned to its original pitch. A reed was also applied to a cylindrical tube, and it was shown that a sharp-edged orifice opened at the middle point of the tube rendered it impossible to produce any note until a cylindrical nozzle was introduced, when the octave was sounded freely. The general results proved that lateral holes had a double function, the pitch of the notes emitted varying with their size, shape, and length, the actual severing of continuity in the principal tube being a comparatively minor point. Dr. Stone then inserted three tubes, varying in length from 2 to 6 inches, in a cylindrical tube like that of a clarinet, at right angles to its length, the longest being placed at the centre of the instrument, and the shortest at one-eighth from the mouth-piece. The same note was produced when each tube was used singly, and when the three were employed; and Dr. Stone expressed a hope that a series of experiments would render it possible to develop curves, in which the co-ordinates would be the lengths of the additional tubes and their position in the instrument. He also considered that a new instrument might be produced, in which the side orifices acted purely as nodal points, by the assistance of friction and the contracted vein.

SOCIETY OF PUBLIC ANALYSTS.

Members are informed that the next ordinary meeting of this Society will be held on Wednesday next, May 5th, at Cannon Street Hotel, at 4 p.m., when it is hoped that the importance of the business will ensure a large attendance. The Council will present a special report as to the steps they have taken in reference to the "Sale of Food and Drugs Bill, now before Parliament, and the further action which they suggest as desirable. Amongst the papers to be read and discussed will be the following:—"On a Simple Method of taking the Melting-Point of Fats," by J. W. Tripe, M.D.; "On Angell and Hehner's mode of Determining the Fusing-Point of Fats," by Arthur Angell; "On a Method of taking the Melting-Point of Fats," by Charles Heisch; "On the Minimum of Solids in Milk," by J. Campbell Brown, D.Sc., &c.; "Practical Suggestions as to the best Method for Public Analysts to adopt in reference to Local Boards, Inspectors, &c., especially as to the Receiving, Dividing, Sealing, and Reporting on Samples," by G. W. Wigner; "On Milk Ash," by J. A. Wanklyn, M.R.C.S., and A. A. Nesbit; "On Tartaric and Citric Acids," by A. H. Allen.

ADULTERATION NOTES.

Dr. Cameron has recently submitted to the grand jury his annual statement of the analytical work performed by him as Public Analyst for the County of Dublin. From this statement we learn that the total number of samples analysed during the year was 78; 28 of these were found to be adulterated, and 13 convictions were the result. The total amount of the penalties was £48.

In the previous year, the samples analysed were 88 (against 78); number of convictions obtained, 17 (against 13); penalties imposed, £88 (instead of £48). Thus, though the number of samples taken and the number of convictions obtained in the two years was very nearly the same, the amount of the fines imposed in the more recent year was only about half. Does this mean that smaller fines are being inflicted for the same offences, or that the adulteration practised is of a more innocent kind than formerly?

It appears that the grand jury, on receipt of Dr. Cameron's report passed a resolution requesting the Government to strike out the word "knowingly" wherever it occurs in the "Sale of Food and Drugs Bill," and to amend the measure in some other respects.

Mr Wigner, Public Analyst for Greenwich, Plumstead, and Woolwich, at the request of the Plumstead District Board of Works, presented to that body, in the early part of the present month, a comprehensive report on the working of the Adulteration Act since the date of his appointment. From this report, it appears that, in the district of Plumstead, his examination has extended to a great variety of articles. The report points out that, taking the entire term, the proportion of adulterated articles in Plumstead has been about 10 per cent of the whole; whereas from published reports it would appear that the average proportion of adulteration, in an aggregation of forty or fifty other districts, is about 27 per cent. The Analyst notices that certain kinds of adulteration have sensibly declined; and, in the case of alum in bread, he states that, in the three extensive Metropolitan districts for which he acts, it is now all but unknown. On the other hand, in spite of special attention having been given to the article of milk, and numerous prosecutions instituted, it is a noticeable fact that comparatively little improvement has taken place. This Mr. Wigner attributes partly to the ease with which this adulteration can be effected (the presence of a pump and the absence of principle being the only two requirements), but mainly to the extreme leniency with which the Kentish magistrates have dealt with offenders. This view is certainly corroborated by a comparison of the police reports in some of the northern towns with those of Greenwich, Plumstead, and Woolwich. The report concludes with various suggestions in reference to the "Sale of Food and Drugs Bill" now before the House of Commons.

The Plumstead Board ordered a copy of this report to be sent to the Local Government Board.

The action of the two local authorities to which we have referred is, we think, to be commended, as being calculated to strengthen the hands of the Society in their efforts to amend the present Bill.

SOME RECENT PROSECUTIONS FOR ADULTERATION.

At the Frome Petty Sessions, Mr. F. Hoddinott, of Butt's Hill, was summoned for selling 2 ozs. of adulterated mustard to police-constable Westcott. Mr. Dunn appeared for the defendant, and called defendant's assistant, named Porter, who stated that he called the policeman's attention to a label on the tin in which the mustard was kept, which stated that it was a mixture of pure mustard with farina and other choice condiments; but this was denied by the policeman, and the defendant was fined 5s. and costs. The same defendant was also charged with selling 2 ozs. of adulterated tea to Westcott on the same day. The evidence showed that the sample which the policeman purchased was adulterated, to the extent of 5 per cent, with counterfeit tea and mineral matter, but was not injurious to health. Mr. Dunn, for the defence, produced a certificate to the effect that Messrs. Morgan and Harper, of Bristol, of whom the defendant purchased the tea, had had it analysed when in bond, and had pronounced it commercially good and free from deleterious impurity. The Bench said they must convict, and they fined the defendant 5s. and costs. Mrs. Rachel Ann Legg,

Henry Watson, and Mr. Edward Philp, grocers, of and Mr. Samuel Dodimead, of Mells, were each including costs, for selling adulterated mustard. ntry, near Wellingborough, on Saturday, Mrs. h, grocer, of Daventry, was charged with adulterated with roasted acorns. Mr. Hep- llingborough, appeared for the defendant. n inspector appointed under the Adultera- t on February 9th he purchased ¾ lb. of endant's shop, and was served by the told that the coffee was to be analysed. ple of the coffee to Dr. Young, who had been examined, and found to roasted acorns. In answer to the that when he told the manager analysed he said—"All right; and grind it ourselves." Mr. ly prove that the coffee was in ndant bought it. The analyst t remark to him—that this liar to this county. It did that the dealers of this e, should have become lterated to so large an t with elsewhere. If, ounty obtained their ndon, it seemed in- uld find its way to ought to be ad- why his applica- lysis be made. ion should be be made a test ... his client, who obtained ...sts. James Brothers, of Wellingbo- ... also of Messrs. Travers and Co., of London. These gentlemen were most anxious for the matter to be sifted, for, he might add, this form of adulteration was unknown in the trade. The coffee was bought by the defendant in the berry state, when it might be supposed that a large admixture of roasted acorns would be noticeable. Mr. A. Roberts, manager to the defendant, said that he supplied the coffee from a drawer kept solely for ground coffee. The coffee was received from Messrs. James Brothers, of Wellingborough. Defendant dealt with no one else for coffee. It was bought in berry. Witness saw it in that state, but did not notice anything in particular. The coffee supplied to the inspector was ground on the previous day. It was roasted before it came to them. The Bench considered that the case had been made out, and inflicted a fine of 20s. and costs.

On Monday, at the Ramsgate Police-court, Mrs. Elizabeth Elgar, grocer, of the parish of St. Lawrence, was summoned under the Adulteration Act for having sold ¼ lb. of butter, which was stated to be adulterated. Mr. Watford, of Ramsgate, appeared for the defendant. Thos. Golding, an assistant to Inspector Taylor, said that on March 14th he was requested by Mr. Taylor to go to the defendant's shop and purchase ¼ lb. of butter, which he did, and paid 6d. for it. He afterwards handed the butter to Mr. Taylor, who took it to the county analyst. Dr. Adams, analyst, said that he had examined the butter, and found it was adulterated with 20 per cent of foreign fat. Mr. Watford, for the defence, contended that a conviction could not take place unless the defendant sold the butter knowing it to be adulterated, or unless the adulteration was proved to be injurious to the health of the person who consumed it. He called William E. Butler, who said he was an assistant to the defendant. The butter was sold in exactly the same condition as it was received from the wholesale shop, and it was believed to be a pure article. Mr. Fells, a wholesale grocer and cheesemonger, of Ramsgate, said that he supplied the defendant with the butter in question: it was sold at 1s. per lb. The Bench convicted the defendant, and fined her 5s. and costs; the Chairman observing that it was upon the sellers alone that the Act of Parliament placed the responsibility of seeing that the articles they sold were not adulterated.

On April 14th, at the Brackley Police-court, Mr. George Kennedy, grocer, of Grimsbury, was charged with selling ¼ lb. of ground coffee, contrary to the Adulteration Act, on February 9th. Defendant was represented by Mr. Crosby. Inspector Botterell gave evidence as to the purchase of the coffee. On the 1st inst. he received a certificate from Mr. Young, to whom he had submitted the coffee for analysis, as follows:—"Percentage of ash, 3·68 per cent; specific gravity of 10 per cent decoction, 1·0068, equal to 16 per cent soluble matter; farina or starch, none; sugar or saccharine ingredients, traces. Microscopic appearance most unsatisfactory. Remarks: adulterated with at least 20 per cent of roasted acorns." Mr. Crosby said the coffee had been supplied to the defendant by Mr. R. Stevens, grocer, Banbury, who had instructed Mr. Beesley to analyse the sample left with the defendant. Mr. Thomas Beesley, analytical chemist, Banbury, said he had examined the coffee microscopically and chemically, and there was no adulteration present whatever. The case was adjourned, the coffee to be submitted to a third analyst. This adjourned case was heard on the 26th inst. Since the last hearing a further portion of the same sample had been analysed by Dr. Letheby, who, like Mr. Beesley, pronounced the coffee to be perfectly pure. The Bench dismissed the case, and told the Solicitor for the defendant to send in the amount of costs his client had incurred, and they would consider whether they should be paid.

NOTICES OF BOOKS.

The Disposal of the Slop-Water of Villages. By C. B. Fox, M.D. London: J. and A. Churchill.

ALL methods for disposing of the refuse of towns and villages seem doomed to leave a dangerous, or at least doubtful, residuum unprovided for. The water-closet system, whilst removing all excrementitious matters, soapsuds, &c., leaves such substances as oyster-shells, fish bones, tails, &c., the peels of potatoes and turnips, the outer leaves of cabbages, and, in short, an extensive assortment of animal and vegetable refuse, to ferment in the dust-bins. The dry-closet system, which Dr. Fox justly thinks best adapted to the wants of villages, is embarrassed with "slop-water." This fluid consists of soap-lyes, rinsings of plates, dishes, and the like, water in which vegetables have been boiled, and a small quantity of urine. Such a mixture is obviously distinct from sewage, and, both as regards its quantity and quality, is ill adapted for treatment by any "sewage" process. On the other hand, it is obviously unfit to be run into any stream the water of which is used for drinking or in cookery; nor can it, as is too often the case, be safely allowed to stagnate in pools and ditches.

Dr. Fox discusses at some length the various means of dealing with such "slop-waters." Of surface irrigation, whether with sewage properly so-called, or with slop-water, he does not feel at liberty to speak with approbation. "In the first place," says he, "I cannot refrain from expressing my doubts as to the wisdom of irrigating land on an extensive scale amongst the villages of our rural districts, impressed as I am with the fear that an augmentation of the amount of pulmonary consumption and other tubercular affections might occur. Physicians well know the intimate relation between dampness of soil and the prevalence of these diseases. The continued maintenance of acres of land in the immediate vicinity of nearly every village in a wet state is a measure attended with some hazard, which should not be overlooked."

We are much interested thus to find our own views on the sanitary results of irrigation confirmed by so acute and

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thoughtful an observer. In a commercial point of view, he expects nothing from irrigation with slop-water. The cottagers of Shenfield, whose gardens have been irrigated with slop-water for six years, are well pleased at being able thus to rid themselves from a nuisance, "but the vegetables grown on the gardens so treated do not exhibit much benefit, if any, therefrom." On the other hand, in a careful experiment made by the author, "ground was rendered three times more productive by adding to it the contents of the earth-closet." This is an interesting little fact for "exploders of the sewage difficulty," who wish us to believe that fœcal matters are worthless!

We have had great pleasure in reading this small, but suggestive, book, and consider it a very valuable contribution to sanitary literature.

The Analysts' Annual Note-Book, 1874. By Sidney W. Rich. London: Printed and published by the Author.

We have here the first issue of a new yearly periodical, devoted exclusively to analytical chemistry. Such new or improved processes as have appeared during the past year are collected and arranged in alphabetical order. So far, therefore, the "Note-Book" is merely a reprint of matter which has appeared in the scientific journals or in independent works. From the preface, however, we learn that the author hopes to secure for future issues an "unquestionable practical value," and to present his readers with original matter, by means of the following plan:—He "will undertake to pay ten guineas to the contributor of the most valuable article, or series of notes for publication in the issue for 1875, on the conditions subjoined: (1) That there shall be at least three *bona fide* contributions; (2) that there shall have been no previous publication of the paper, or of the substance of the paper; (3) that there shall be no publication in any other form until six months after the publication of the "Analysts' Annual Note-Book" in which they first appear . . . . ; (6) the papers must be sent in before the 31st of October, 1875."

We are by no means certain that this project, supposing it carried into execution, would have any beneficial effect on chemical science, or that it would be any convenience. At present, any new or improved analytical procedure is immediately made public; it "goes the round" of the scientific journals, it is discussed at the meetings of societies, and is experimentally tested by numerous and independent operators under the most varied circumstances. Under Mr. S. Rich's plan, a new method, say, for the determination of nitrogen, discovered in January or February, 1875, would not be in the hands of the scientific world until January, 1876. We fail to see the advantage of such a delay.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 12, March 29, 1875.

Researches on the Sugar Beet-root.—E. Fremy and P. P. Dehérain.—The authors infer from their experiments that beet-root can reach a normal development in a soil perfectly devoid of human, if they are watered regularly, and receive manures containing nitrogen, phosphoric acid, lime, and potash. The form in which the nitrogen is presented appears indifferent nitrates of potash and soda, sulphate of ammonia and nitrogenous organic matter all exerting a manifest action. Beet-roots cultivated in a soil which acts merely as a support, and nourished with chemical manures, may contain 18 per cent of sugar. The chemical nature of the soil does not appear to have any sensible action on the development of the beet-roots; the same results having been obtained with soils consisting respectively of pure silica, of lime, or of a mixture of silica, lime, and clay. The beet-roots rich in sugar are poor in albumenoid matters, and inversely. Bad results may be obtained from the best seed if sown in a soil containing an excessive proportion of nitrogenous matter.

Pyroxenic Constituent of the Rock Associated with Platinum in the Ural.—M. des Cloizeaux.—The author has studied the crystallographic and optical characters of the mineral in question.

Dissolution of Hydrogen in Metals, and on the Decomposition of Water by Iron.—MM. L. Troost and P. Hautefeuille.—In previous researches on the metallic alloys formed by hydrogen (*Comptes Rendus*, lxxviii., 686 and 807), the authors indicated the characters which distinguish these definite combinations from the solutions of hydrogen in metals. Potassium, sodium, and palladium, combine with hydrogen, whilst a considerable number of other metals merely dissolve this gas. Iron, nickel, cobalt, and manganese offer striking analogies in the manner in which they behave with hydrogen at different temperatures. The facility with which they absorb or give off hydrogen gas depends greatly on their physical condition. An ingot of pure nickel gave out, in a vacuum, at a red heat, one-sixth of its volume of hydrogen. Laminæ of nickel, obtained electrolytically, gave out forty times their volume. Pulverulent nickel gave up one hundred times its volume, and remained pyrophoric after the escape of the hydrogen. An ingot of cobalt gave up one-tenth of its volume; electrolytic laminæ of cobalt thirty-five times their volume, and pyrophoric cobalt powder one hundred times. It also remained pyrophoric after the loss of the hydrogen. Soft iron in ingots gives off one-sixth of its volume, and grey cast-iron more than the half. Electrolytic laminæ of iron gave off 260 volumes. In fine, it may be said that iron, nickel, and cobalt absorb directly hydrogen gas, but it cannot be said that combination ensues, just as has been already shown in the case of lithium and thallium. Finely divided iron has a property which is not shared by nickel or cobalt: it decomposes water slowly at common temperatures, and rapidly at 100°. In this respect iron approximates to manganese.

Chemical Equilibrium between Gaseous Iodine and Hydrogen.—M. G. Lemoine.—This paper requires the accompanying diagram.

Rapid Process for the Detection of Lead in the Tin Lining of Vessels.—M. Fordos.—Place, with a tube plunged in pure nitric acid, a slight layer of acid upon any part of the tinning, selecting by preference the thickest parts. Both metals are attacked, forming stannic oxide and nitrate of lead. After a few minutes, heat slightly to expel the last traces of acid, and allow to cool; then touch the pulverulent spot produced by the acid with a tube dipped in a solution of 5 parts of iodide of potassium in 100 of water. The iodide has no action upon the oxide of tin, but with the nitrate of lead it reacts, forming yellow iodide of lead, and showing the presence of even a small quantity of this metal. The surface of the tinning must be carefully cleansed before applying the nitric acid, and the acid should not penetrate to the iron or copper which forms the body of the vessel, as the reaction might thus be complicated.

Relation between the Nature of Steels and their Coercitive Force.—MM. Trève and Durassier.—Not suitable for abstraction.

Internal Double Reflection in Birefrangent Uniaxial Crystals.—M. Abria.—Not adapted for abstraction.

Researches on the Uric Acid Group.—M. E. Grimaux.—The author has obtained parabanic acid as a product of the splitting up of the pyruvic ureides.

Gazzetta Chimica Italiana, Anno iv., Fascicolo 9 and 10, 1874.

Expansion of Phosphorus.—G. Pisati and G. de Franchis.—A very lengthy paper, and quite incapable of useful abstraction.

Action of Sulphur upon Water and upon Carbonate of Lime.—Prof. Tullio Brugnatelli and Dr. P. Pelloggio.—The authors have investigated the oxidation of sulphur in contact with water and carbonate of lime, and have concluded from their experiments that the oxygen of the atmosphere takes no part in this reaction.

Nature and Constitution of Tannic Acid.—Ugo Schiff.—This paper contains analyses of the tannates of ammonia, potash, soda, baryta, antimony, bismuth, copper, mercury, cadmium, lead, and iron. There are also some remarks on the composition of laurostearin, and on the correction of old organic analyses, in the calculation of which incorrect equivalents have been employed.

Measurement of the Indices of Refraction of Cymen, Benzol, and some Derivatives of Natural and Synthetic Thymol.—G. Pisati and E. Paterno.—Not adapted for abstraction.

Economical Chrome Green.—Adolfo Casali.—The author states that the existing chrome greens, such as Guignet's green (hydrated sesquioxide of chrome), called also emerald green, and Pannetier's green; green ultramarine (anhydrous chromic oxide), Leune and Castelhaz's green (hydrated chromic oxide), Arnaudon's green (chromic metaphosphate ?), Matthieu Plessy's green (phosphate), leave little to be desired in point of beauty, and are free from injurious properties, but are too expensive to compete with the arsenical greens. He proposes in their stead to calcine strongly an intimate mixture of 1 part of bichromate of potash and 3 parts of baked gypsum, of the variety commonly known as scagliola. The result is a grass-green mass, which, on boiling with water, or mixing with dilute hydrochloric acid, leaves a fine powder of an intense and beautiful green, and possessing a very high colouring power.

Detection of Amylic Alcohol in Spirit of Wine.—Dr. Ciro Betelli.—Dilute 5 c.c. of the suspected alcohol with 6 or 7 volumes of water. Add 15 or 20 drops of chloroform, shake strongly, and leave at rest. The deposit of chloroform is collected, and allowed to evaporate spontaneously, when the amylic alcohol is left as a residue, and may be recognised by its well known odour, its reaction with sulphuric acid, &c.

Volumetric Process for the Determination of Phosphoric Acid.—J. Macagno.—The author proposes to determine the molybdic acid in the phospho-molybdic precipitate, and calculate from it the phosphoric acid. He acidulates the alkaline solution of the molybdic precipitate with hydrochloric or sulphuric acid, and adds zinc. The molybdic acid is reduced to sesquioxide with an intense brown colour. On treating this with a standard solution of permanganate, the sesquioxide returns to the state of molybdic acid, and the liquid becomes colourless. The phospho-molybdic precipitate, dried at 100°, has the following composition:—

Molybdic acid	90·744
Phosphoric acid..	3·142
Ammonia	3·570
Water	2·544
	100·000

Revue Universelle des Mines, de la Metallurgie, de Travaux Publics, des Sciences et des Arts Appliques a l'Industrie, January and February 1875.

The Rotatory Puddling Furnace of Mr. Crampton, and Bessemer Steel Works.—M. A. Habets.

Magnetic Observations made in Belgium in 1871.—**Stephen L. Perry.**

Report on the Mineral Industry of Italy in 1873.—M. Jules Axerio.

Production and Consumption of Coal.—Victor Bouhy.

Note on a Steam-Boiler Accident, due to the Extraordinary Thinness of Sheet-Iron.—M. van Hees.

Geometric Demonstration of Zeuner's Diagram.—M. Armand Reigler.

Concessibility of Iron Mines.—M. Descamps.

The Electric Light.—A notice of the improvements effected by M. Ladyguine.

Mining Industry of Algeria.—Besides excellent iron ores, there are in Algeria deposits of zinc, lead, and copper.

Warner's Procedure for the Purification of Cast-Iron.—M. E. Rigo.

Action of Cold upon Iron and Steel.—An account of J. P. Joule's experiments, taken from *Iron*.

Cousin's Parachute.—M. Gille.

Electro-Dynamic Machine, and Electric Light Regulator of Siemens and Halske.—With diagrams.

MISCELLANEOUS.

Incorporation of the Royal Veterinary College.—We are glad to find that the Queen has been pleased to grant Her Royal Charter of Incorporation of the Royal Veterinary College. Among the powers bestowed on the College is one of creating scholarships, and of awarding medals, prizes, and certificates of distinction to the students. When to this is added the power of appointing former students of the College Licentiates, or those who have practised with particular distinction in their profession, Fellows of the College, with a right to use these distinctions publicly, it will be seen that the means of elevating the profession do not stop with the mere obtainment of scholastic honours as a stimulus to progress. The Charter also empowers the Governors to bestow the higher honour of Honorary Associate on distinguished persons, native or foreign, who have contributed in an especial manner to elevate veterinary science.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the preparation of ozone and ozotic acid, and in apparatus used therein. Bristow Hunt, Serle Street, Lincoln's Inn, Middlesex. (A communication from Alvaro Francisco Carlos Reynoso, chemist, Paris.) June 23, 1874.—No. 2181. Preparation of ozone. The fundamental principle of novelty in the preparation of ozone consists in operating upon oxygen gas compressed to several atmospheres. Electric sparks are caused to pass through the mass by means of particular arrangements, which increase the surfaces and multiply the number of the electric sparks. The apparatus is composed of a vessel capable of resisting great pressure. The electric sparks are disengaged between two conductors terminated by several points placed at suitable distances. Preparation of azotic acid and azotates by means of compressed air. Air is compressed to several atmospheres above water, or alkaline bases, or carbonates, and through the same are passed electric sparks produced by means of a "Ruhmkorff" coil placed in communication with an electro-magnetic machine moved either by hydraulic power, the wind, by compressed air, or otherwise. The sparks will be disengaged by points or systems similar to those above mentioned with regard to ozone.

Improvements in materials or compositions for destroying insects on animals, plants, and other objects, and for protecting them therefrom. Alexander McDougall, Penrith, Cumberland. June 25, 1874.—No. 2208. This invention consists in the admixture of the composition described in the Specification of Letters Patent, No. 2510, 1860, with sulphur and a liquid obtained by washing the oil produced between the spirit or naphtha and the pitch in the destructive distillation of carbonaceous substances with an alkali; also in taking carbolic acid other than "crude carbolic acid," and making it into a paste or composition in a manner similar to that described in the aforesaid Specification, and adding sulphur thereto.

Improvements in the process of rendering alkalies caustic, and apparatus for that purpose. John Imray, Southampton Buildings, Chancery

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Lane, Middlesex. (A communication from Hermann Kühne, Magdeburg, Germany.) June 29, 1874,—No. 2242. According to this invention a heated solution of carbonate of potash or soda is mixed with quicklime in a vessel so as to render the alkali caustic, and the mixture is then run into a lower vessel having an opening at bottom covered with a sieve, over which is spread a layer of gravel and sand: the caustic alkali filters through this layer, leaving the carbonate of lime deposited on the filter. When the alkali has filtered through, the vessel is filled with water so as to force out the residue of alkali held by the deposited lime, and this, together with the water, is then discharged through a flap-valve. A number of the lower vessels are arranged in combination with one upper vessel, so that each of the former receives a charge from the latter in rotation.

An improved composition for coating the hulls or bottoms of iron ships, to preserve them when in sea or other water, also applicable for the like preservation of any iron, wood, or stone. James Burrell, marine engineer, Hammersmith, Middlesex. June 29, 1874.—No. 2248. The coating is made of two distinct compositions, the one being mixed with any drying oil, and the other with any undrying oil. The two compositions will be used either separately or combined: if used together the drying composition to be used first, and afterwards the undrying composition. But in some cases it is not absolutely necessary to use any of the drying composition, as ordinary paint can be used first, and then the undrying composition may be put on over it. The coating composed of the material hereinafter named is to be ground or pulverised quite fine, and mixed together and thoroughly incorporated, and it should be of the consistency of thick paint. The several proportions, however, may be varied to suit the different purposes, or some of the material may be left out altogether. The colour can also be altered or varied by adding any suitable colouring matter. For the making of the first composition I propose to employ of—

Cinnabar	about 15 parts.
Calamine..	„ 10 „
Rosin	„ 20 „
Chalk or lime..	„ 85 „
Arsenic (any colour) ..	„ 10 „
Any drying oil or varnish	„ 10 „
Petroleum or turpentine	„ 8 „
Sugar of lead	„ 2 „
Red lead or red oxide ..	„ 10 „
Total	100 parts.

Another composition or a modification of the above will be made as follows:—

Sulphur	about 16 parts.
Mercury	„ 4 „
Arsenic (red)	„ 10 „
Oxide of zinc	„ 10 „
Sugar of lead	„ 4 „
Rosin or bitumen	„ 20 „
Red lead or any colouring material	„ 6 „
Any drying oil or varnish	„ 10 „
Petroleum or turpentine	„ 10 „
Chalk or lime..	„ 10 „
Total	100 parts.

The chalk or lime is to be subjected before mixing to the action of coal-gas, or carbonic acid gas, or the two combined. If chalk is used it is to be perfectly dry, then broken quite fine, and enclosed in a close box or case, and it is to be continually moved, so that all parts will be submitted to the action of the gases. In the making of the second or last coating I employ of—

Cinnabar	about 20 parts.
Calamine or oxide of zinc	„ 20 „
Prepared chalk or lime	„ 20 „
Arsenic	„ 10 „
Sugar of lead	„ 5 „
Any drying oil that will cause the materials to adhere together	„ 25 „
Total	100 parts.

A variation or modification of the above or last coating will be made as follows:—

Sulphur	about 16 parts.
Mercury	„ 10 „
Arsenic	„ 14 „
Prepared chalk or lime	„ 20 „
Oxide of zinc	„ 10 „
Red lead, or red oxide of iron, or any suitable colouring material ..	„ 5 „
Any undrying oil that will cause the materials to adhere together ..	„ 25 „
Total	100 parts.

Or a further composition may be made of sulphur, mercury, prepared chalk, or lime, and arsenic mixed with any undrying oil, or tallow, or fatty compounds that do not harden by exposure to the atmosphere (or water*). The whole or either of the above compositions can be applied and used just as ordinary paint is applied, and either with or without heat.

* The words "or water" are found in the copy of the abridgment delivered by the applicant, but do not appear in the original abridgment.

Improvements in the construction of filters, and in the preparation of materials used for the purification of water. Gustav Bischof, Professor of Technical Chemistry, Andersonian University, Glasgow. June 29, 1874.—No. 2243. This invention relates to the construction of filters and preparation of materials for purifying water. In the improved construction of filters a dished bottom is provided under the ordinary perforated bottom separating it from the receptacle for the filtered water. A bent pipe leads from this dished bottom to the exterior, where it is stopped by a cock or plug; and a small hole in the bent pipe gives passage for the filtered water to the receptacle, the hole being so adjusted in size as to prevent a rush of water through the filter when a quantity is withdrawn from the receptacle. The bent pipe serves also to discharge the water used for cleaning the filter. The porous balls or slabs ordinarily used for filtering are impregnated with a solution of a salt of iron, and the ferrous oxide of iron is precipitated in their pores by impregnating them with an alkali or alkaline carbonate. This oxide becomes by exposure hydrated ferric oxide, which has a purifying effect on the water, and which may be directly mingled with the filtering materials.

Improvements in lubricating compounds. Bridget French, Rochester, Monroe, New York, U.S.A. June 29, 1874.—No. 2249. The invention consists in the combination with petroleum, or equivalent oil of paraffin, with other ingredients, also in the combination with petroleum, or equivalent oil of steatite, or soapstone, or French chalk, for the purpose of producing a lubricating compound.

Improvements in the manufacture of sugar from the cane and other sugar-yielding materials, and in apparatus used therein, partly applicable for preparing nourishment for animals. Bristow Hunt, Serle Street, Lincoln's Inn, Middlesex. (A communication from Alvaro Francisco Carlos Reynoso, chemist, Paris.) June 30, 1874.—No. 2255. This invention consists in extracting the juice of the sugar-cane by first cutting the cane in pieces by means of a knife, and in then reducing the pieces to pulp by means of a rasp, and in then submitting the pulp to the action of an ordinary press, by which the juices are separated from the pulp; or in submitting it thereto after having mixed with it lime and phosphate of lime or any other matter suitable for causing defecation, or in submitting it thereto after having boiled it.

Improvements in the manufacture of gas and fuel. Alexander Melville Clark, patent agent, Chancery Lane, Middlesex. (A communication from Charles Jenty, Paris.) June 30, 1874.—No. 2270. This invention relates to the manufacture of gas for illuminating and heating purposes from naphthalin ($C_{20}H_8$) and petroleum oil, which are absorbed by a porous body capable of yielding proto-carburetted hydrogen, and distilled in ordinary gas apparatus, the coke residue forming an excellent fuel.

Improvements in the manufacture of alum and products resulting therefrom. William Beatson, the Chemical Works, Rotherham, York. June 30, 1874.—No. 2272. This consists, first, in employing an excess of sulphuric acid so as to convert muriates (or chlorides) of soda or potash into bisulphate of soda or potash, whereby the muriates are entirely decomposed. The resulting compound is boiled with clay or shale until a neutral solution of alum is obtained, which is crystallised in the usual manner. Second. In burning the clay or shale in conjunction with small coal or fuel in a tall upright kiln; and, third, in utilising the residue of the clay or shale for making soluble silicates, hydraulic or other similar cement, and bricks or artificial stone.

NOTES AND QUERIES.

Indigo Printing.—Could you give me any information how to stiffen acid extract of indigo for block printing? I want it as stiff as possible. I have tried flour-paste, and I find the acid works on it and it goes thin in a few days. Could you suggest any better substitute? They have a knack in Lancashire of stiffening their extract that we have not in Yorkshire.—Old Subscriber.

MEETINGS FOR THE WEEK.

Monday, May 3rd.—Medical, 8.
—— Royal Institution, 2. General Monthly Meeting.
Tuesday 4th.—Civil Engineers, 8.
—— Zoological, 8.30.
—— Royal Institution, 3. Prof. Gladstone, "On Chemical Force."
Wednesday, 5th.—Society of Arts, 8.
—— Microscopical, 8.
Thursday, 6th.—Royal Institution, 3. Prof. Seeley, "On the Fossil Forms of Flying Animals."
—— Chemical, 8. N. Story Maskelyne, "On Andrewsite and Chalkosiderit." Walter Flight, "An Examination of the Methods for the Separation of Iron Sesquioxide, Alumina, and Phosphoric Acid." W. Ramsay, "On Sodium Ethylthiosulphate." J. Williams, "On a Milligrade Thermometric Scale."
Friday, 7th.—Royal Institution, Weekly Evening Meeting, 8. Prof. Cornu, "On the Velocity of Light," 9.
—— Geologists' Association, 8.
Saturday, 8th.—Royal Institution, 3. The Rev. Mark Pattison, "A Chapter of University History."
—— Physical, 3. Mr. H. Bauermann, "On the Electric Conductivity of Anthracite Coal." Mr. W. Crookes, F.R.S., "The Radiometer."

THE CHEMICAL NEWS.

VOL. XXXI. No. 806.

RED CHALK AND RED CLAY.

By Professor A. H. CHURCH.

SOME years ago I published an analysis* of the red chalk of Hunstanton, Norfolk. The specimens which I examined more minutely were those in which the red colour, so characteristic of this variety of chalk, was exceptionally developed. In these specimens I found a high percentage of ferric oxide, with very little silica and alumina. Mr. R. C. Clapham had shown,† however, that some samples, at all events, of red chalk contained as much as 9·28 per cent of silica, with 9·6 per cent of ferric oxide and 1·42 per cent of alumina, and that these three ingredients were also present in white chalk, though in much smaller proportions.

In view of the recent discoveries as to the materials constituting the floor of the deep sea, and acting upon a suggestion made by Professor J. Morris as to the probability of some near connection between red chalk and the "red clay" of certain deep tracts of the ocean bottom, I have again studied the chemical nature of the former material; but this time I employed a different method of analysis, and I operated upon the paler and more ordinary variety of red chalk. The samples used were numerous, but the results of the treatment to which they were submitted were nearly uniform.

The following is a brief outline of the plan which was pursued in order to see if it were possible to separate from red chalk a red clay, slime, or ooze, similar to that which is reported by the officers of the *Challenger* Expedition to cover the Atlantic bed at average depths of some 2700 fathoms. Treatment with very dilute hydrochloric acid in the cold seemed the best way of removing the calcium carbonate present. This acid was allowed to act upon small crushed pieces of selected red chalk until fresh acid failed to remove any further traces of calcium. By appropriate washing in an apparatus similar to that figured in my "Laboratory Guide,"‡ the finer portion of the undissolved residue from the chalk was readily separated from the siliceous fragments which accompanied it. This finer portion remains suspended for some time when stirred up in pure water, and was found to be almost, if not quite, homogeneous; it contained no lime. It amounted, on the average, when air-dried, to 9·3 per cent of the weight of the chalk taken, but some dark samples furnished higher percentages. Its physical characters correspond, so far as I can learn, to those of the red residue obtained by Mr. Buchanan from the Globigerina ooze, and to those of the smooth red clay before referred to as brought up from the deeper parts of the sea-bottom.

The following analysis abundantly proves how closely the chemical composition of the red argillaceous residue from red chalk resembles the red clay in question:—

Analysis of Red Clay from Red Chalk.

	In 100 Parts.		
	Air-Dried.	Dried at 100° C.	Ignited.
Water	14·73	7·54	—
Silica	52·87	57·33	62·01
Ferric oxide (Fe_2O_3) ..	12·81	13·89	15·02
Alumina	15·65	16·97	18·36
Magnesia (MgO) ..	2·65	2·87	3·11
Potash (K_2O)	1·33	1·45	1·56
	100·04	100·05	100·06

Although the above numbers clearly indicate a substance which may be fairly designated "a silicate of red oxide of iron and alumina," like the "red clay" of Professor Wyville Thomson,* it would be idle now to speculate as to the probable correspondence, in the minuter details of their composition, of the red chalk residue with the red clay of the deep Atlantic and Southern Sea. Still it may be profitable to allude to two or three points which are likely to throw light upon the relationship of the white, grey, and red chalk with the globigerina, the grey and the red ooze, respectively. First, analysis seems to show that the removal, in different degrees, of calcareous matter, however effected, has been the main cause of the differences of such formations. Secondly, it would appear that, although manganese dioxide is present in granules and nodules in the red oceanic clay and in the coarser particles of the red chalk, it is absent alike from the finely-divided substance of the former and the similar red residual slime of the latter. And, thirdly, the suggested relation between both these red matters and the mineral known as *glauconite* receives an unexpected light through the detection of sensible quantities of magnesia and potash in the red chalk residue; for the latter base is an invariable constituent, and the former an usual one of this species.

The complex and rather variable silicate which, from its grey-green hue, has received the name of glauconite, is known both in ancient and recent formations of green sand. The casts of animal forms which constitute the glauconitic grains of cretaceous greensand strata are paralleled by similar remains in the recent greensands of the Australian seas, and of those of the Agulhas current investigated by the scientific staff of H.M.S. *Challenger*. But the problem of the formation of recent greensand, or rather of glauconitic matter, at moderate depths, and of the related red clay at very great depths is not yet solved. It is by no means necessary to suppose that glauconite was always first formed, and that it yielded the red clay in question by oxidation and partial solution, just in the same way that kaolin or white clay has been produced from felspar. This has probably happened in some instances; but it may be assumed, on the other hand, that the same constituents have yielded one or other of these two products, in accordance with differences in the dissolved gases and salts of the ocean and in the nature of its prevalent animal and vegetable forms.

One step towards the discovery of an answer to the problem now under discussion might be furnished by a careful study of the action, under pressure, of water holding oxygen and carbon dioxide in solution, upon powdered glauconite. But we really stand in need of more information as to this species itself, for the composition of the numerous minerals included under this name is somewhat ill-defined. Still we may conclude that it contains, as essential constituents, silica to the extent of 50 per cent; a variable amount of alumina; much iron in the ferrous, as well as in the ferric condition; several per cents of potash; a little magnesia; and, finally, about 7 or 8 per cent of water. It would not require a very profound alteration of such a mineral to give it the composition indicated by the analysis of our red chalk residue, when dried at 100° C. Such alteration would involve peroxidation of the iron, removal of most of the potash, and relative increase of the alumina, results commonly seen in many altered mineral residues.

Great interest attaches to all questions concerning the red oceanic clay. Its minute analysis will, doubtless, solve some of the problems referred to in the present imperfect note. In the meantime, I am anxious that it should not be supposed that I ignore the differences which must subsist between recent oceanic deposits and the rocks which we may consider to have originated in former ages from similar materials. It is not that the mere process of consolidation must have altered them, but that the influences to which they have been subsequently exposed may have caused unsuspected, though not inconsiderable,

* 1863. *Journ. Chem. Soc.* (2), vol. i., p. 99.
† 1852. CHEMICAL NEWS, vol. vi., p. 313.
‡ "Laboratory Guide," 3rd edition, 1874, p. 163.

* *Proc. Roy. Soc.* vol. xxiii., pp. 59 and 45.

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changes in their chemical constitution. Materials for the discussion of this question are still deficient, and we must await complete quantitative analyses of recent glauconite, and of the red oceanic clay, before a decision can be reached. On account of this insufficiency of data, I have refrained from suggesting any formula for the red chalk residue, though it may have, like kaolinite, a claim to be regarded as a mineral species.

LECTURES ON THE MORPHOLOGY OF CRYSTALS AT THE CHEMICAL SOCIETY.

By NEVIL STORY MASKELYNE, M.A., F.R.S., &c.

(Continued from page 155).

Lecture XIII.

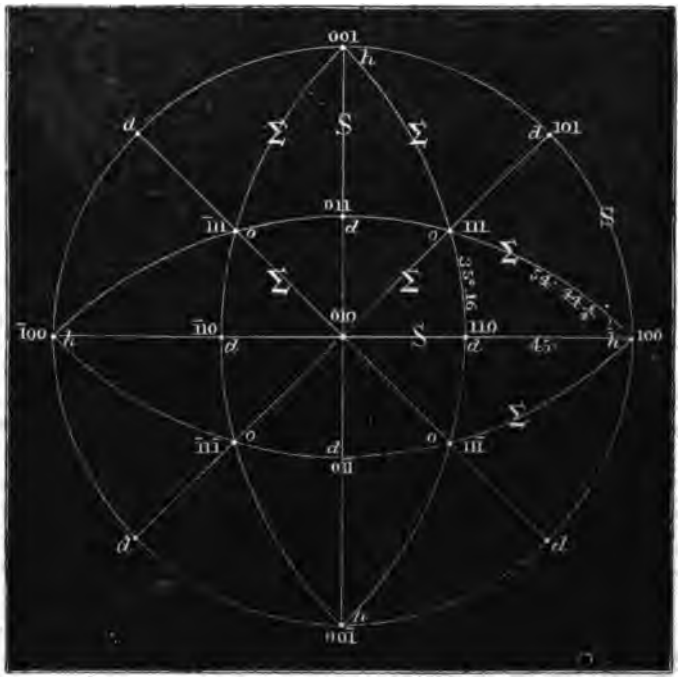
In the preceding lectures all the cases in which a crystal can be conceived as symmetrical to a series of its planes lying in a single zone have been considered: there remain, however, those various cases to be discussed which may result from planes not belonging to the same zone being planes of symmetry. One might, for instance, put questions such as these:—Suppose in a trigonal or hexagonal system that other planes of symmetry intersected with the planes S and C at crystallometric angles; or, again, suppose in the tetragonal system that the plane C were to become conformable with either the S or the Σ group of planes, in which case new planes of symmetry would intersect at 45° with the planes in question in their zone axis; and every supposition that we can frame of this kind would readily receive an answer from trigonometry. The principle of a systematic triangle that has been introduced in previous lectures enables us, however, to deal with this problem from a more general point of view.

Since the systematic triangle represents the smallest spherical triangle that any system admits of, of which the sides are arcs of zone circles of symmetry, and since therefore the angles of such a triangle can only have crystallometric values, it becomes a very simple trigonometric problem to determine what systematic triangles are at all possible. They are—taking a, b, c for the angles, and A, B, C for the arcs opposite to them—only the following:—

	a.	b.	c.	A.	B.	C.
I.	90	60	60	70 31 7	54 44 15	54 44 15
	90	60	45	54 44 15	45	35 15 85
II.	90	90	60	$\frac{\pi}{2}$	$\frac{\pi}{2}$	$\frac{\pi}{3}$
	90	90	30	$\frac{\pi}{2}$	$\frac{\pi}{2}$	$\frac{\pi}{6}$
III.	90	90	45	$\frac{\pi}{2}$	$\frac{\pi}{2}$	$\frac{\pi}{4}$
IV.	90	90	90	$\frac{\pi}{2}$	$\frac{\pi}{2}$	$\frac{\pi}{2}$

In the six cases, by which we have here exhausted all the possible varieties of a systematic triangle, we recognise the last four as representing the symmetrical relations of the trigonal and hexagonal, of the tetragonal and of the orthorhombic, systems. It remains for us to consider the character of the systems resulting from the first two kinds of systematic triangles. They will be severally represented by figures. But it will be seen that great circles passing through the poles h, in pairs, are potentially also planes of symmetry, and in this case the two kinds of symmetry under consideration become identical; since the zone circles $[hh]$, Fig. 14, will bisect each and every of the systematic triangles in the former of the two cases, forming new systematic triangles which fulfil the conditions of having their angles crystallometric. This condition, however, is not fulfilled by the zone circles passing through adjacent pairs of poles, d, since the spherical triangle formed by the sides $d\,t$, $d\,o$, $o\,t$, in Fig. 14, has its angle at $d = 67°30$, which is not a crystallometric angle; nor are the adjacent spherical triangles repetitions by symmetry of this triangle. It results from this that the

Fig. 13.



poles o are poles of trigonal, but not of hexagonal, symmetry: the poles h, on the other hand, are tetragonal poles, and the poles d are ortho-symmetrical in character. In fact, the system under discussion presents us with three planes of symmetry, containing the zone circles, $[h\,h]$, perpendicular to each other, which we may call the proto-systematic planes S; and, further, six planes of deutero-symmetry, Σ, intersecting in triads in the axes $[o]$ and in pairs perpendicularly in the axes $[h]$, in which they intersect at 45° with the great circles S, each plane Σ again meeting a plane S perpendicularly in a zone axis $[d]$. The poles h and o represent those of the well-known figure, the cubo-octahedron; the poles d are those of the rhombic-dodecahedron, or 12-faced rhombohedron. Forty-eight systematic triangles partition the surface of sphere, so that the most general form of this system—and therefore, also, the most complex single form in crystallography—is the 48-faced scalenohedron, known as the hexakis-octahedron $\{h\,k\,l\}$. The planes S are naturally axial planes of the system; they are parallel to the faces of the cube, and the crystallographic axes are their normals. A face of the octahedron intersects at equal distances with each of these axes, so that the parameters of the crystal are equal.

The systematic triangle has, as we have seen, for sides—

$$H = 35°\ 15'\ 35'' \qquad D = 54°\ 44'\ 15'' \qquad O = \frac{\pi}{4},$$

and for angles—

$$h = 45° \qquad d = 90° \qquad o = 60°,$$

and the axial system is represented by the expression—

$$\begin{matrix} \xi = \eta = \zeta = 90 \\ 1,\ 1,\ 1, \end{matrix}$$

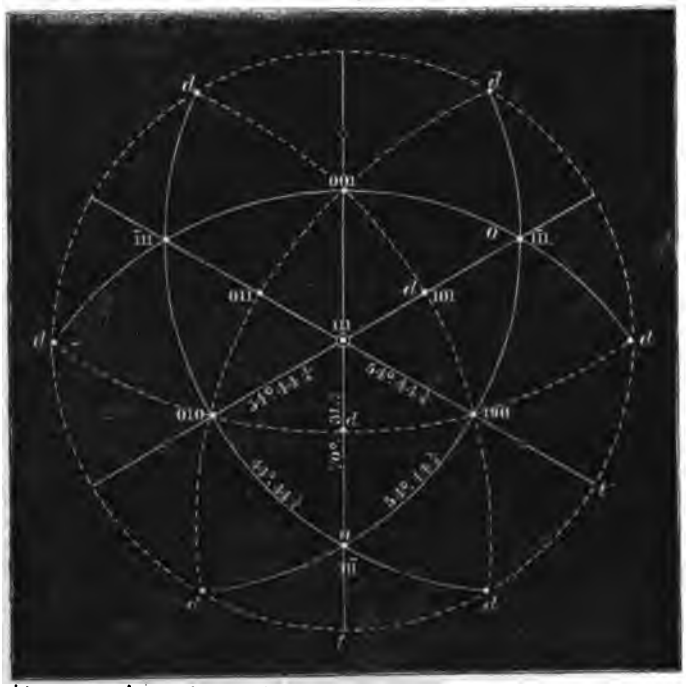
wherein it will be seen that the five variable elements of the crystal are all employed in fulfilling the requisite conditions (involving one more than the tetragonal system involves, viz. this, that the planes C and S of that system are conformable), and, consequently, all crystals in this system are so far isomorphous. If all the permutations that can be performed on the position of the indices in the symbol $\{h\,k\,l\}$ of the hexakis-octahedron be combined with all the different varieties in sign which those indices can undergo, it will be found that a symbol will be obtained for each one of the forty-eight faces, with a determinate position on the sphere.

The characters of the several forms the poles of which lie on the arcs or at the angles of the systematic triangles were next considered, though not in detail, since their descriptions are to be obtained in any of the ordinary works on crystallography.

Taking $h > k > l$, the symbol $\{h\,k\,k\}$ was that of the 24-faced figure, the icositetrahedron; the form $\{h\,k\,l\}$ being that of the triakis-octahedron, and the form $\{h\,k\,o\}$ that of the tetrakis-hexahedron: the poles h of the cube belong to the form $\{1\,0\,0\}$; the poles d of the rhombic-dodecahedron to the form $\{1\,1\,0\}$; and the poles o of the octahedron to the parametral form $\{1\,1\,1\}$.

Of the merosymmetrical forms of this system, the α symmetrical kind being unexemplified in Nature, the holo-

FIG. 14.



systematic hemihedral forms, including the tetrahedron, $\kappa\{1\,1\,1\}$, the hexakis-tetrahedron $\kappa\{h\,k\,l\}$, the trigonal dodecahedron $\kappa\{h\,k\,k\}$, and the triakis-tetrahedron $\kappa\{l\,h\,h\}$, were alluded to. In them the S planes are only potential, while the Σ planes are actual planes of symmetry. The hemi-systematic forms—in which the planes Σ are potential, while the planes S are actual planes of symmetry—are centro-symmetrical; such are $\pi\{h\,k\,l\}$, the dyakis-dodecahedron, and $\pi\{h\,k\,o\}$, the pentagonal dodecahedron, a figure not to be confounded with the regular dodecahedron of geometry. A tetarto-hedral form exists in this system, the dyakis-hexahedron $\kappa\pi\{h\,k\,l\}$, consisting of twelve irregular pentagons. It

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is remarkable, in this respect, that the crystals which carry it as a form exhibit rotatory polarisation similar to that exhibited by quartz.

ERRATA.—P. 64, col. 2, lines 13 and 14 should read as follows:—"symmetrical to S, and potentially to a plane of which *n* is the pole. So *m* and *n* are possible planes, and, on the assumption of," &c. P. 102, col. 2, line 14 from bottom, *for* its *read* each. P. 102, col. 2, line 10 from bottom, *for* signs *read* sides. P. 111, col. 2, line 7 from bottom, *for c read* C.

ON THE OCCURRENCE OF PHOSPHATES IN THE CAMBRIAN ROCKS.*

By HENRY HICKS, F.G.S.

IN this paper the author showed from experiments that the Cambrian strata in Wales contain a far greater amount of phosphate and carbonate of lime than had hitherto been supposed. The results published by Dr. Daubeny some years ago, and which have since received the support of some eminent geologists, were proved therefore to be entirely fallacious when taken to represent the whole Cambrian series; for though some portions show only a trace of these ingredients, there are other beds both interstratified with and underlying these series, which contain them in unusually large proportions. The author, therefore, objects to look upon Dr. Daubeny's experiments as tending in any way to prove that the seas in which these deposits had accumulated contain but little animal life, and that we had here approached the borders of the lower limit of organic existence. He contended that the presence of so much phosphate of lime, and also of carbonate of lime, as was now proved by analyses made by Mr. Hudleston, F.C.S., Mr. Hughes, F.C.S., and himself, to be present in series of considerable thickness in the Longmynd group, Menevian group, and Tremadoc group, proved that animal life did exist in abundance in these early seas, and that even here it must be considered that we were far from the beginning of organic existence. The amount of phosphate of lime in some of the beds was in the proportion of nearly 10 per cent, and of carbonate of lime over 40 per cent. The proportion of phosphate of lime, therefore, is greater than is found in most of what have been considered the richest of recent formations. The amount of P_2O_5 was also found to increase in proportion to the richness of the deposit in organic remains. It was found that all animal and vegetable life had contained it from the very earliest time; but it was apparent that the Crustacea were the chief producers of it in the early seas; and of the Crustacea, the trilobites more particularly. It was always found where they were present, and the shell of some of the larger trilobites, as now preserved, contain as much as from 40 to 50 per cent of phosphate of lime. The analyses made by Mr. Hudleston and the author of recent Crustacea proved that they also contain P_2O_5 in very considerable proportions.

In the second part of the paper the author showed that where intrusive dykes had passed through or between the beds containing the phosphate of lime, the beds for some distance on each side of the dykes had undergone a considerable change. Scarcely a trace of the P_2O_5 or of the lime was now to be found in them, though it was evident that before the intrusions into them had taken place, they, like the other portions of the beds, had evidently contained both ingredients in considerable proportions. It was well known that heat alone could not separate P_2O_5 from lime; therefore he found it difficult to account for this change in the character of the beds, unless it could be produced by gases or watery vapour passing into them at the time the intrusions took place. He thought it even probable that the dykes, which in some parts are found to contain a considerable amount of lime and also P_2O_5, might have derived these, or at least some portions of these, from the beds through which they had been forced, and which must have been broken up and melted as they passed through them. There are no contemporaneous tuffs known in Wales of earlier date than the Llandeilo beds; and he thought these dykes belonged to that period, and that they were injected into the Lower Cambrian beds after from 8,000 to 10,000 feet of deposit had been superimposed. In an agricultural point of view the author considered that the presence of so much phosphate of lime in some of the series of beds must be a matter of great importance; and on examining the districts where these series occurred, he invariably found the land exceedingly rich.

Mr. Hudleston gave the results of the analyses made by him at the request of Mr. Hicks. He found in a portion of dark grey flaggy rock taken from close to a fossil 1·62, in a portion of black slaty rock containing trilobites, but in contact with trap 0·11, in a portion of the shell of a trilobite 17·05, and in the trap above mentioned 0·323 per cent of phosphoric anhydride. A lobster-shell dried at 100° C. gave 3·26, an entire boiled lobster (undried) 0·76, and a boiled lobster without shell 0·332 per cent of P_2O_5. If the analysis of an entire lobster be correct, he estimated that a ton of boiled lobsters would contain about 17 lbs. of phosphoric anhydride. In the analysis of the shell of a trilobite there appears to be a great excess of phosphoric acid, which Mr. Hudleston thought must be due to substitution.

Prof. MASKELYNE said that the solution of the question of the diminution of the phosphate of lime near intrusive rock was easy. The intrusive rock in cooling would contract, and thus facilitate the percolation from above or the forcing up from below of water, which flowing through the adjacent rocks would dissolve out the phosphate of lime. He remarked that north of Cardigan Bay pisolitic iron ore was found charged with phosphate of lime.

Mr. D. FORBES stated that when, many years ago, Dr. Daubeny maintained that the Cambrian rocks only contained mere traces of phosphoric acid, he had published (in 1857) chemical analyses of some of the oldest then known limestones, showing that these contained quite as much phosphoric acid as recent ones. He considered that the larger proportion of phosphate of lime found in the fossil Crustacea, as compared to the recent, was mainly due to the fact that, besides the organic matter, carbonate of lime had also been removed from them; and that the reason of the casts of *Paradoxides* near dykes of igneous rock containing only traces of phosphoric acid and lime was rather the removal of these substances by water than the igneous action of the dyke. He could not agree in believing that the phosphoric acid found in eruptive rocks was derived from the sedimentary fossiliferous beds through which they passed, but regarded it as an inherent constituent of the eruptive rock itself. Even the Menevian and Laurentian rocks were after all only made up of the *débris* of previous eruptive rocks; and he looked upon the eruptive rocks as the original source of all the phosphoric acid assimilated by animal and vegetable life. He regarded this paper as a most valuable contribution to geological science.

Mr. KOCH enquired whether any Vivianite had been obtained by Mr. Hicks.

Prof. SEELEY thought that the paper, interesting as it was, did not bring us any nearer to the source of the phosphate of lime in phosphatic deposits, especially such as those recently described by Mr. Davies as occurring in the Bala beds. The proportion of phosphoric acid in the ash of the lobster did not appear to be greater than in that of plants; and whilst the *debris* of marine animals would be rapidly dispersed, those of seaweeds would remain at the bottom, and it was to these that he was inclined to attribute the accumulation of phosphate of

* A Paper read before the Geological Society of London, March 24, 1875.

lime in these deposits. At the same time he believed that the phosphoric acid was primarily derived from volcanic rocks, out of which the phosphates have been washed by water. The great proportion of phosphate of lime in the shell of the trilobite was probably due to infiltration.

Mr. HUGHES said that he had examined many soils in Australia and elsewhere, and that when the soil was deficient in phosphate of lime the underlying rock was the same, but when the soil was rich in phosphate the rock also contained it. He had also found phosphoric acid in igneous rocks from the north of England and Scotland.

Mr. TOPLEY enquired as to the amount of phosphoric acid in the flesh of the lobster. He remarked that the shells of the gault were largely phosphatised, and that they seem to have drawn their phosphoric acid from the surrounding rock. There are many phosphatic nodules in the lower part of the gault, and also on the surface of the Kentish rag.

The AUTHOR, in reply, said he thought it possible that water, or rather watery vapour, may have washed out the phosphate of lime from the altered beds; but he contended that this must have taken place at the time the intrusions occurred, for at present these beds are as solid and impervious to water as are the beds in which the phosphate of lime is now present. He stated that he did not intend to say that there were no contemporaneous traps of so old a date as the Menevian beds, but that there were none in Wales of earlier date than the Arenig or Llandeilo series; he had even mentioned that there were some in Canada of the age of the Laurentian rocks; but as there was no evidence of any of these in Wales, we could not look upon the phosphate of lime in these beds as having been obtained from dissolved apatite. In reply to Prof. Seeley, he said he could not allow that some beds lost all their phosphate of lime by percolation of water, and that the fossils in the others obtained it by the same means. He did not suppose, however, that all the phosphate of lime present in the fossil shell occurred in the natural shell, and he believed that it had to some extent in the process of fossilisation replaced carbonate of lime.

Mr. HUDLESTON, in reply to Mr. Topley first, said that his calculations of the percentage of phosphoric acid in the lobster were based upon the amount compared with the total contents of the animal itself, as this seemed the most suitable for purposes of geological inquiry. That ratio once established, other calculations might be made. The phosphates in these as in other sedimentary rocks must be regarded as a sort of residuum or ash, the result of the decomposition of nitrogenous organic matter which was left after the more volatile carbon, hydrogen, nitrogen, and oxygen had, under various combinations, more or less completely disappeared. Calcium phosphate is known to be the chief constituent of the ash of most albuminous principles; analyses of these were quoted. The question of the loss of phosphoric acid in the rock adjoining the trap was one of much difficulty; but as an instance somewhat similar, Bischof was quoted to the effect that large quantities of calcium phosphate occur in basalt in the vicinity of a guano deposit at the Isle of Ascension.

THE COKE-MANGANESE GALVANIC CELL.

By SERGIUS KERN, St. Petersburg.

THE well-known Leclanché's cell is now in use for many purposes, giving a very constant current, but which, however, is much decreased by the resistance of the tar covering the top of the porous cell, and by the decomposition of the manganese dioxide, which is transformed during the action of the cell into manganous oxide; the latter oxide closes the pores of the cell. My cell is a modification of Leclanché's one, and the experiments proved it to act very constantly.

Two parts of cleanly washed coke, and one part of manganese dioxide (MnO_2) in the state of powder, are well mixed together with a small quantity of water acidulated with some drops of nitric acid; the mixture then is strongly pressed into brown paper cartridges 0·125 metre high and 0·03 metre diameter. The resulting coke-manganese cylinders are dried in a warm place, but not over a fire, because the heat, as it is known, decomposes the manganese dioxide.

The dried cylinders are placed in glass jars containing concentrated solution of ammonium chloride (NH_3HCl), and surrounded with zinc-plates curved in the usual manner. By this arrangement the use of porous cells is avoided, and a battery of such elements acts more constantly; besides this, the construction of it is cheaper. Instead of having glass jars, I am using wooden boxes, the size of the glass jars; the internal parts of the boxes are covered with the following mixture, melted in an iron cup:—2 parts of wax, 10 parts of common resin (colophony), 2 parts of red-lead, and ½ part of gypsum.

The zinc of the element is the negative pole; the coke, the positive pole. The reactions which take place in this element may be represented by the following equations:—

$$2NH_3HCl+2Zn=2ZnCl_2+2NH_3+H_2;$$
$$H_2+MnO_2=MnO+H_2O.$$

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

The Elements of Water.† By Dr. A. OPPENHEIM.

Oxygen.—Like the evolution of human life, the development of every chemical art is connected with oxygen; Directly or indirectly, it intervenes in every manufacturing operation. With equal necessity, life and technology derive it from that exhaustless source of all being, the atmosphere. Furthermore, no discovery has had a greater significance for the history of culture than that of the material nature of the air, and the discovery—the centenary of which we commemorate this year—of its most important constituent, oxygen gas.‡ To the same discoveries chemical industry owes its rational foundation and the possibility of its advancement, and thus both the existence and the progress of technology are linked to the same element. What, in comparison with these incalculable benefits, are the advantages which pure oxygen gas has conferred upon industry by its direct application? To give a reply to this question is the object of the following lines, and as no reports or text-books have hitherto treated this subject in a connected manner, we may venture to exceed in point of time the boundaries of this report.

Lavoisier, who first recognised in its full extent the importance of oxygen, took the first successful step in its technical application. "It is evident," he writes,‖ "that atmospheric air is not the most suitable to increase the action of fire, and that, if we drive a current of air upon ignited fuel by means of bellows, three parts of injurious, or at least useless, gas are driven in for one part of the serviceable kind of air, and that, therefore, if the latter could be used for combustion in a pure state, the action of the fire would be much enhanced. This idea has doubtless occurred to many persons prior to myself, and I

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† "Die Elemente des Wassers."

‡ "On the 1st of August, 1774, I endeavoured to extract air from mercurius præcipitatus per se."—Joseph Priestley, "Experiments and Observations on Air," ii., 106. See also Kopp, "Geschichte der Chemie," iii., 200 and 204.

‖ "Memoire sur un Moyen d'Augmenter Considérablement l'Action du Feu et de la Chaleur dans les Operations Chimiques."—"Oeuvres de Lavoisier ii., 425.

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hear that Archard, the celebrated chemist of Berlin, has carried it into application;* but it is still needful to devise a cheap and convenient apparatus."

For this purpose, Lavoisier used at first bladders fitted with tubes and taps. "I made," he continues, "with a knife, a hole three to four lines deep in a large piece of charcoal, and laid in it 6 grs. of platinum, set fire to the charcoal at an enameller's lamp by means of a blowpipe, opened the jet of my apparatus, and blew pure oxygen into the hollow. The charcoal burnt very rapidly, with detonation as it produces with melted saltpetre, and with a dazzling brilliance; and in a few moments the platinum melted into granules, which then united into a ball. The fusion was equally successful, whether the ordinary platinum of commerce was taken or such as had been previously freed from magnetic particles by means of a magnet. Hitherto, platinum has not been melted."

Lavoisier improved his apparatus in the same year,† in conjunction with Meusnier, and produced a gasometer consisting of two boxes, and which on a small scale much resembled those now in use at gas-works. About the same time, Saron constructed two blowpipes (*chalumeaux*), one of which delivered oxygen and the other hydrogen. By their means, however, Lavoisier did not succeed in fusing platinum.‡ He hoped, however, to construct an improved blowpipe, in which the oxygen should surround the hydrogen, and thus was developed the plan of the oxyhydrogen blowpipe, which has rendered such essential service in the metallurgy of platinum and in soldering lead.

The application of oxygen for melting platinum remained dormant until, in 1857 to 1859, Deville and Debray made known their important investigations§ on the platinum metals, and introduced the industrial fusion of platinum. The autogenous soldering of platinum, and the production of fused ingots on the large scale, was first carried out by Johnson, Matthey, and Co., of London, and also by Heraeus, of Hanau, in Germany.

Debray's and Deville's experiments led, above all, to the discovery of a refractory material for crucibles and furnaces. For this purpose quick-lime offered itself, which has the further advantage of retaining the heat as completely as possible. The chemists above-named increased the heat further by leading the flame from above directly upon the surface of the metal, and determined the amounts of oxygen and hydrogen theoretically and practically necessary for melting 2 kilos. of platinum, *i.e.*, by calculation, 55 litres of oxygen and 110 of hydrogen. The amount actually fused was more than 1 kilo, so that —a highly favourable result—not 50 per cent of the heat produced was wasted. These experiments had a further bearing upon the industrial history of oxygen, as they led to the comparison of the cost of the methods of its production and to the search for a less expensive process. We may divide the known methods into chemical and mechanical, subdividing the former into continuous and interrupted procedures.

(To be continued.)

Inaccuracy of Determinations of Nitrogen in Manures.—A. Bobierre.—The author shows that in the analysis of oil-cake, a smaller or larger portion of the ammonia liberated may be dissociated, according to the conditions under which the combustion is carried on. The losses may amount to 2½ per cent of the total nitrogen in the sample. To avoid them it is necessary not to use too long a combustion-tube, to employ a gas- instead of a charcoal-furnace, and to conduct the operation rapidly. —*Comptes Rendus.*

* *Memoiren der Berliner Academie*, 1779. "Sur un Nouveau Moyen de Produire avec une tres Petite Quantité de Charbons une Chaleur," &c.

† Lavoisier, "Oeuvres," ii., 432.

‡ Lavoisier, "Oeuvres," ii., 430.

§ Deville and Debray, 1859. *Ann. Chim. Phys.*, lvi., 385. *Dingler's Polyt. Journ.*, cliv., 130, 199, 287, 383.

PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

On Wednesday last, the 5th inst., an ordinary general meeting of the Society was held at Cannon Street Hotel. The President (Dr. Redwood) was in the chair, and the meeting was numerously attended by members from various parts of the country.

The minutes of the last meeting having been read and confirmed, Mr. Wigner (Joint Secretary) read the following report of the Council:—

To the Society of Public Analysts.

Gentlemen,—The Council beg to present a Report of the steps they have taken since our last meeting, on February 5th, in reference to the proposed repeal of the "Adulteration Act, 1872," and to the "Sale of Food and Drugs Act, 1875." At that date it will be remembered that, though an intimation had been given of the probable introduction of a new Adulteration Bill, the draft of such Bill was not printed, and its provisions were therefore entirely unknown. Considering it desirable, however, that the views of this Society should, if possible, be embodied in the Bill on its first seeing the light, rather than in subsequent amendments, we addressed a letter to the Secretary of the Local Government Board, requesting him to receive a deputation for the purpose of hearing certain representations which we were prepared to make, as to some features which we considered it important should appear in the new Bill. For convenience, we classified the points referred to under thirteen heads. To this letter we received a most courteous reply from Mr. Clare Read, conveying the thanks of the President of the Local Government Board for the suggestions we had offered, and expressing his hope that many of them would be found to be met in the forthcoming Bill, of which Mr. Read promised to send us an early copy. Agreeably with this promise Mr. Read forwarded to us, on the 16th of February, a draft of the "Sale of Food and Drugs Bill."

Seeing at once the urgency of our immediately taking this Bill into our consideration, the Secretaries summoned a Council meeting by telegraph, for February 18th. At this meeting, which was a protracted one, the Bill was debated clause by clause, and, as a result, the Secretaries were instructed to urge upon the Government—either orally or by letter, or by both means—certain amendments in the Bill, which appeared to the Council to be of vital importance. Conformably with this instruction the Hon. Secretaries sought and obtained an interview with Mr. Read on the following day, being the date fixed for the second reading, when various points were urged upon him. To the reasonableness of some of these amendments he at once assented, and promised a full consideration to the whole of them. The Secretaries, not being content to rely wholly upon Government support, had an interview with Dr. Lyon Playfair, who went at great length and with much interest into the matter, and whose speech on the second reading displayed an ability and a comprehensive grasp of the subject unapproached by any other speaker.

A further Council meeting was held on March 2nd, when Mr. Wigner submitted a form of certificate as an amendment to the one printed in the Schedule of the Bill. This was unanimously adopted, and the Secretaries requested to transmit a copy of the same to the Local Government Board, together with some further suggestions for amending the Bill.

The Bill being now fairly before the public, articles appeared in many of the newspapers severely criticising its provisions. Amongst others the *Times* published a very able article on the subject, which, however, contained what appeared to be a reflection on the Public Analysts,

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and to which, therefore, our Secretaries felt it their duty to reply. Their letter, which appeared on the 25th of February, formed the subject of a further leader in the *Times*, and was also extensively copied and commented upon by various other London papers. The views of the Council, besides being ably advocated by the *Lancet* and other medical and chemical papers, were put forth and explained week by week in the CHEMICAL NEWS, a paper which, it has been gratifying to find, has come to be referred to—by Members of Parliament and others—as an authority on the question.

The Bill was put down for Committee for March 4th, but was only committed *pro forma*, for the purpose of its being reprinted. It was shortly afterwards issued in its revised form, when it was noticeable that—though still a very imperfect measure—many of the blemishes to which we had called special attention had been removed. Our definition of "*food*" was inserted in place of the one originally given. The words "knowingly" and "usages of trade," to which we had offered the most strenuous objection, were found—the latter entirely, and the former in several cases—to have been expunged from the Bill. The labelling clause was amended in accordance with our suggestion, a provision being inserted to ensure distinctness and legibility. One most important matter—which had been wholly unprovided for in the original Bill—the Government had, in the amended Act, made provision for, namely, the punishment of the wholesale dealer, on the strength of whose false warranty the retailer would have escaped punishment for selling adulterated articles. In numerous other minor points, too, it was evident that the Local Government Board had not only considered our suggestions, but adopted them.

The Bill being fixed for Committee on March 19th, the Secretaries again wrote to Mr. Read, reiterating their objections to certain clauses in the Bill, and pointing out other defects to which notice had not already been drawn. They also addressed other Members of Parliament known to be alive to the importance of the purity of the food supply, and received gratifying expressions of support. To Dr. Cameron, one of the Members for Glasgow, the Council have to express their special obligation for the great interest he manifested in the question, and for the valuable amendments he has placed on the paper.

The Bill did not (from pressure of other business) come before the House on the day fixed, nor did it on April 5th, when it was again on the paper,—on which date the Secretaries addressed another note to the Local Government Board, but on one point only. It has all along been the opinion of the Council that the proposed reference of disputed cases to the Laboratory at Somerset House was objectionable in the highest degree, and would be fraught with injustice to Analysts of standing and reputation; but so strong was the party advocating this, that the Council almost despaired of maintaining their opposition. When, however, Sir Henry W. Peek (who is supposed to specially and directly represent the grocery trade) gave notice of an amendment to the effect that the Somerset House certificate should be considered *final*, it became obvious that a strong protest must be made to prevent as gross a piece of injustice as could be imagined. It was therefore pointed out to Mr. Clare Read that whoever made an analysis for the purpose of verifying or disproving the correctness of a previous analysis, whether he was in Somerset House or not, should be compelled, if necessary, to verify his analysis on oath; and that, without such a stipulation, the character of an Analyst—no matter how high his standing or how great his attainments—would be utterly at the mercy of some Government subordinate, who would be irresponsible, and *might* also be incompetent. The President and Secretary of the Local Government Board wrote, thanking us for our letter; but as the clause in question has not yet been reached in Committee, it remains to be seen what action will be taken in reference to the matter in question.

At length, after various postponements, the Bill was partially considered in Committee on the 20th of April; but it came on very late, and but little progress was made, only the fifth clause being reached. Clause 2 was altered so as to take "water out of the definition of "food," thus laying it down clearly that no Public Analyst can be called upon to analyse water under the new Act. This is an improvement, as in some districts it has been considered a part of the Analyst's duty to examine the water supply. In Clause 3 another of the remaining "knowinglys" has been eliminated, and this (in view of securing convictions) is extremely important. In Clauses 4 and 5 there have been slight changes in the phraseology, in each case for the better.

In addition to the voluminous correspondence which has passed between the Secretaries, the Local Government Board, and various Members of Parliament, and the numerous interviews they have had with members of the Government and others, we must mention that the President of the Society (Dr. Redwood) and one of the Vice-Presidents (Mr. Wanklyn) waited upon Mr. Sclater-Booth, and laid before him very fully their views on the proposed Somerset House scheme.

NUMEROUS remarks were made, and questions asked, as to the amendments of the Bill which at present stand on the notice paper of the House of Commons, and were duly replied to by Members of the Council. After a full discussion the report was unanimously approved.

Scrutineers were appointed to examine the voting papers sent in by the members, and reported as the result that the following gentlemen had been elected:—

As an Honorary Member—R. Angus Smith, Ph.D., F.R.S., F.C.S., &c., Manchester.

As Members—M. A. Adams, F.R.C.S., Maidstone; A. H. Church, M.A. (Oxon), Cirencester; V. Cruse, F.C.S. Ipswich; Wm. Edward Porter, F.C.S., Worcester; B. H. Paul, Ph.D., London.

As Associates—F. J. Lloyd; S. J. Weston.

The following paper was then read by the AUTHOR:—

ON AN EASY METHOD OF TAKING THE MELTING-POINT OF BUTTER AND OTHER FATS.

By JOHN WILLIAM TRIPE, M.D.,
Medical Officer of Health, and Analyst for the Hackney District.

HAVING been much dissatisfied, nearly twelve months since, with the methods then in use for taking the temperature at which butter and other solid fats melt, I tried several plans, but without success. It struck me, after a time, that advantage might be taken of the difference between the specific gravity of the fat and the water in which it is melted, and I therefore cut some tubing—having a bore of about $\frac{1}{4}$th of an inch in diameter—into lengths of $4\frac{1}{2}$ inches, rather more than half filled them with the fat to be tested, and, after labelling them, put them aside to cool. I then selected a beaker which fitted sufficiently closely to an opening in the water-bath, and, filling it with water at 65°, dropped it into the opening, so as to allow the beaker to be kept suspended by its rim in the water contained in the bath. The tubes, which were open at both ends, were then placed in the beaker, with a delicate thermometer, and a small gas-burner placed below the water-bath, so as to raise the temperature of the contained water very slowly. As the fat melted in the tubes it rose up, in consequence of the water entering at the lower end, and the temperature at which it rose was read from a thermometer placed with them in the beaker. The experiment was very satisfactory, as its repetition with the same fat gave the same temperature in all cases within a degree, and generally within a smaller range.

Simple as the process is, certain precautions must be adopted to make it successful. Some of these are incident to all methods of taking the temperature of the melting-point of fats, such as previously drying and cla-

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rifying the fat to be tested, so that we melt the pure fat only. Others are those peculiar to the plan to be used, and I therefore proceed to point them out very briefly:—

In the first place, the tubing should have an uniform calibre, otherwise it will necessitate a more perfect melting of the fat before it rises in the tube: if the tube is to be stood upright in the beaker, which is the best position for it, the end of the tube to be placed in the water should be slightly uneven or notched, so as to allow of the free ingress of water; the tube should also be long enough to stand at least ½ an inch above the rim of the beaker, so as to admit of its ready removal. It is better to place the finger on the end of the tube, and take it out of the water immediately the fat is melted, than to allow it to remain there and distract attention from other samples. The object of placing the finger on the end of the tube, before taking it out, is to prevent the fat from running out of the lower end into the water.

Before filling the tubes, care must be taken to have them perfectly dry and clean, and, if the laboratory should be cold, it is better to have them warmed to about 65° or 70° F., so as not to set the fat too quickly. Indeed, if the fat of mutton suet is to be tested, a higher temperature is advisable. A plug should also be made to fit that end of the tube which is to be placed in water, so that when the fat has been drawn in to the requisite height the finger may be put over the upper and the plug into the lower end, so as to prevent the melted fat running out. It is also advisable to keep the tube upright until the fat is quite cold, in which case it will stand on the end of the plug. Before taking the melting-point the plug must, of course, be taken out, if not previously removed, which it is always better to do as soon as the fat is cold and firmly set. Care should also always be taken not to test for the melting-point until perfect solidification has occurred. The height to which the tube should be filled will depend partly on the depth of the beaker, as in no case should the upper part of the fat be above the level of the water in which it is to be placed; indeed it is better that it should be at least ½ of an inch below the top of the water. The size of the interior of the tube is also of some importance, as, if the bore be less than $\frac{1}{12}$th or more than ¼th of an inch in diameter, the results will not be so reliable, because, when larger tubes are used, the fat—when cold—very often will not be in contact everywhere with the sides of the glass, and especially if mutton or beef suet be tested. Thin tubing is decidedly preferable to thick. It is also advisable that a thermometer should be placed in the water-bath, so that you may prevent the temperature of the contained water rising too high and too rapidly, because when the water in the beaker approaches nearly to the melting-point great care has to be used, otherwise too high a temperature will be recorded, owing to the time occupied by the rising of the fat in the tube. For convenience in use, I have had a copper disc made of the diameter of the beaker, with holes punched around the circumference as a stand for the tubes, and another hole in the centre for the thermometer. The disc is suspended in the beaker at about ½ of an inch from the top, and at least ½ of an inch below the surface of the water, by means of three narrow slips of copper, which are bent over the upper edge of the beaker, so that the tubes can be kept upright during the experiment, and the rising of the fat more readily seen. The advantages of this plan are—the uniformity of the results, the ease with which the experiment can be performed, and the simplicity and cheapness of the apparatus. As to the uniformity of the results it is evident that—as the fat rises in the tube as soon as the film in contact with the glass is melted—with due care there should be no variation. There certainly is room for debate as to whether or not the water rushes in and elevates the fat before the true melting-point has been attained,—or even, on the contrary, whether the elevation is not delayed, by adhesion to the tube, beyond the true melting-point: but it is quite clear that the temperature at which it will rise must at all times be nearly the same. In connection with this I would insist on the necessity of perfectly drying and clarifying the fat, as I have found as much difference as 8° F. in the melting-point of the same butter before and after drying, as, of course, the greater the quantity of water in the butter, the lower will be the melting-point. As regards the ease with which it can be performed, it is obvious that any one who has had the smallest amount of laboratory practice can fill the tubes to the requisite height, especially if a mark be made on the side, and also attend to the other details. The only difficulty is to record the temperatures when you have several samples in the water and are using too much heat, as the fat will then rise in one tube after another so rapidly as to necessitate having one person to note down the temperatures and another to call them out. As to the cheapness and simplicity of the apparatus, I need not make any remark, as every one has all the articles required ready at hand.

CORRESPONDENCE.

CORRECTION.

To the Editor of the Chemical News.

Sir,—I will feel much obliged if you will permit me to correct an error contained in a review of my book, "Cholera; How to Prevent and Resist it," which appeared in Chemical News, vol. xxxi., p. 139. A quotation from the book is there given (p. 139. col. 2, l. 29), stating that "a compact sandstone suitable for building purposes will, in a short time, absorb *from five to six times its own weight* of water." This should be "from five to six per cent," which makes a vast difference, but still is a sufficient quantity to illustrate the porosity, *i.e.*, permeability to air, of a much used building material. I must apologise for this tardy correction, but I did not see the review until to-day.—I am, &c.,

Thomas Whiteside Hime.

217, Glossop Road, Sheffield,
April 28, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 13, April 5, 1875.

Singular Case of Magnetisation.—M. J. Jamin.—A magnet, described in a letter from Galileo to Curzio Picchena, had the property of attracting one and the same pole of a bar of steel when at a distance, and of repelling it when near, whilst it attracted soft iron at any distance. The author has met with a similar case.

Limit of the Carburation of Iron.—M. Boussingault.—The author holds that in carburetted iron in fusion the total carbon is in combination with the metal, and that whilst it is cooling a part of the carbon is set at liberty. If the solidification is rapid, graphite is not separated out.

Quantities of Magnetism, and on the Position of the Poles in Slender Needles.—M. E. Bouty.—Not suitable for abstraction.

Physical Properties of Plates of Collodion.—M. E. Gripon.—This membrane reflects light like glass, and polarises it both by reflection and transmission. Its index of refraction is $n = 1{\cdot}5108$. It transmit a very large proportion of radiant heat, for the study of which it is better adapted than mica.

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Formation of Iodic Acid in Iodised Flames.—M. G. Salet.—Iodine volatilised in the flame of hydrogen colours the oxidising region of the flame green, and gives a peculiar spectrum, which is characteristic of this element, but which, it seems, ought not to be attributed to it in the free state. The author has succeeded in demonstrating the presence of a notable amount of iodic acid. This acid, though it begins to decompose at 300°, can therefore be formed at much higher temperatures under the influence of the active oxygen present in the oxidising zone of flames.

Substitution of Mercury for Hydrogen in Creatin.—M. R. Engel.—Not suited for abstraction.

Inequality of Action of Various Isomorphs upon the same Supersaturated Solution.—M. Lecoq de Boisbaudran.—Chrome alum does not appear to dissolve in an appreciable manner in a simply saturated solution of alumino-ammoniacal alum (basic solution). Chrome alum does not dissolve appreciably in such a solution dilute enough to corrode slowly crystals of ammonia-alumina alum, which, moreover, is less soluble than chrome alum. Chrome alum does not grow on its octahedral faces in a solution which is still able to deposit alumina-ammonia alum upon the octahedral faces of this latter salt. The actions upon a solution of two isomorphs, having the same chemical functions, and being geometrically equal, are not identical.

New Procedure for Freeing the Salt Marshes of Southern France from Salt.—M. A. Joannon.—An account of certain agricultural experiments performed at Tournebelle.

Manganiferous Cast-Iron.—MM. Troost and Hautefeuille. –The presence of manganese in cast-iron greatly augments the solubility of hydrogen in the metal, and lessens or destroys that of carbonic oxide.

Carbon of White Cast-Iron.—MM. P. Schützenberger and A. Bourgeois.—Many physiologists admit that carbon set free during the decomposition of the green parts of plants under the influence of solar light unites in the nascent state with water, forming a hydrate of carbon. From this primordial hydrate they derive, by ulterior transformations, the numerous organic compounds of the vegetable kingdom. This theory would find a solid base if it were possible to isolate the carbon of any compound by a reaction at a low temperature, and to establish in this case the formation of a hydrate of carbon. White cast-iron seems very suitable for experiments of this nature. The authors treated a quantity of it in coarse powder with a solution of sulphate of copper, as in Ulgren's process for the determination of carbon. The carboniferous copper which remains is washed, and treated in the cold with a moderately concentrated solution of perchloride of iron, mixed with hydrochloric acid. The copper dissolves rapidly, and there remains a black-brown powder of small bulk, which, after washing with hydrochloric acid and water, and drying at 100°, yielded on analysis—

Carbon	64·00
Water	26·10
Siliceous ash	8·10
Matters not determined	1·80
	100·00

100 grms. of the same cast-iron yielded by our method 7·135 of the black, dry residue. The weight of the crystalline graphite amounted to 1·2 per cent of the carbonaceous residue, and the determination of the combined carbon by Boussingault's method shows 63·1 of carbon for the same residue. The sum of the graphite and the combined carbon is 64·3, a number approaching very near to that (64) furnished by combustion. We may therefore admit, deducting the silicon and other impurities, that the carbonaceous residue is a hydrate of carbon. If heated to 250° it quickly loses its water without swelling.

Central-Blatt fur Agrikultur Chemie,
Heft 1, January, 1875.

Formation of Ozone during the Decomposition and Formation of Water,—Prof. Böttger.—The author proves that not merely on the decomposition of water, but on its formation by the union of the purest oxygen and hydrogen, determinable quantities of ozone are generated.

Influence of Forests upon the Rainfall of a Country.—L. Fautrat and A. Sartiaux.—The authors conclude that the rainfall is greater over well wooded than over cleared districts.

Amount of Water in Walls, and on its Quantitative Determination.—Dr. Jos. Glässen.—The author, though his researches are not yet complete, holds that a house should not be inhabited so long as the moisture exceeds 1 per cent.

Influence of the Chemical Constitution of a Soil upon the Growth of the Chestnut.—P. Fliche and L. Grandeau.—The chestnut is a silica plant, but absorbs also a considerable amount of lime.

Newly Discovered Beds of Phosphorite in Austria.—S. Pick and Meusel.—The newly-found deposit occurs in Schwarzenthal, near Johannisbad, in Bohemia. Its average composition is—

Phosphate of lime	66·79
Phosphate of iron	6·27
Manganese peroxide	4·83
Carbonate of lime	8·54
Fluor calcium	5·26
Silica	5·46

Influence of Sampling Manures upon the Results of Analysis.—J. A. Barral and R. Duval.—The authors point out the difficulty of securing a fair average sample of cargos of guano.

Account of an Experiment on Oats with different Manures.—Bultman.—The highest result in money value was produced by Peruvian guano, and the lowest by Liernür's fœcal manure.

Sub-Soil Manuring.—W. Funke.—This process is recommended for lands which have become crop-sick.

Manufacture of Fœcal Manures at Graz.—J. Moser.—The process employed is precipitation with phosphate of alumina (Forbes and Price's patent).

Influence of Muscular Exertion on the Secretion of Urea.—F. Schenck and Nencki.—The authors deny that the amount of urea is increased by muscular exertion.

Peptones, and Nutrition thereby.—P. Plosz.—The author concludes from his experiments that peptones contribute to the formation of tissue.

Utilisation of One and the Same Fodder by Individuals of Equal Age and Identical Race.—Dr. H. Weiske.

Ratio of Milk to Butter.—Dr. Axmann.—The individuality of an animal has more influence than its race on the yield of milk and of butter.

Fattening Oxen, Swine, and Geese.—M. Eggers-Gorow.

Ferments in Bees, in Bee-Bread, and in Pollen, and on Certain Ingredients of Honey.—Prof. Erlenmeyer and Dr. von Pianta.—The heads, bodies, and abdomens of 152 working bees were extracted with equal proportions of glycerin. The extract of the head inverted cane-sugar in twelve hours; that of the abdomen in seventy-two hours. Both converted starch into dextrin and sugar. The extract of the thorax had a much slower action. Blood-fibrin was dissolved most quickly by the extract of the abdomen, and scarcely, if at all, by that of the thorax. A glyceric extract of bee-bread, and the fresh pollen of the Scotch fir had the same effect.

Two New Foods.—Dr. E. Kern.—An examination of fibrin biscuits for dogs, and of meal for poultry.

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Hybernal Colouration of the Green Parts of Plants.—G. Krauss.

Formation of Gum in Fruit Trees as a Pathological Phenomena.—E. Prillieux.—An extract from the *Comptes Rendus*, p. 1190, 1874.

Presence of Large Quantities of Nitrogen in Two Varieties of Amaranthus.—A. Boutin.—*Amaranthus ruber*, dried at 100°, yielded 16 per cent nitrate of potash. *A. atropurpureus* contained as much as 22·77 per cent.

Glucoses in Rye- and Wheat-Flour.—A. Pœhl.—The author shows that glucose does not pre-exist in these grains, but is formed under certain conditions, one of which is the presence of water.

Composition of Potatos.—Dr. O. Abesser.—It is well known that Balling drew up tables deducing the amount of dry matter in potatos, and their percentage of starch from their specific gravity. The author finds these tables incorrect.

Composition of Tea from Cachar.—Prof. Hodges.—From the Chemical News.

Nutrition of Fungi.—Prof. Ph. Zöller.—The cell devoid of chlorophyll has the power of developing the higher vegetable bodies, such as albumenoids, fats, and hydrates of carbon, from organic acids (acetic acid) in combination with ammonia and the mineral constituents of vegetables.

Experiments on the Cultivation of Sugar Beets, with Analyses of the Crop.—A. Stellter.

Experiments on the Cultivation of New Kinds of Potatos.—Von Schuster.

Influence of the Quality of Seed upon the Crop.—F. Burgtorf.—The author's experiments confirm the view that select seed yields a better crop in proportion to the quantity sown.

Solutions of Sulphate of Copper—as regards their Influence on the Germinating Power of Wheat.—F. Haberland.—The action of blue vitriol is shown to be injurious. The author suggests instead of the use of such solutions to pass the grain rapidly through a space heated from 150° to 200° R., which would kill all adhering spores and germs without injuring the germinating power of the wheat.

Use of Kaolin as a Clarifying Agent.—B. Hoff.—The author denies the statement of Mach, that kaolin, used to clarify wine, attacks its red colour more than corresponding proportions of gelatin or isinglass. Below 10° C. the action of kaolin is imperfect.

Volatile Acids of Wine.—E. Duclaux.—Taken from *Comptes Rendus*, 1874, p. 1160.

Manufacture of Butter from Sour or Sweet Cream.—F. Söltoft.—The experiments appear in favour of sour cream, but the other conditions in the respective trials were not identical, whence the results cannot be considered as decisive.

Adulteration of Coffee.—A. Allen.—From Chemical News, vol. xxix., p. 129, &c.

Use of Carbolic Acid in Preparing Timber.—M. Boucherie.—From *Comptes Rendus*, 1874, p. 1757.

Degree of Heat at which Yeast-Cells Perish.—E. Schulmacher.—In a dry state these cells can bear a temperature of 100° C. for hours, and, for a shorter time, even a heat of 130° C. In the normal, moist condition they are not killed by a temperature of – 113° C.

Anti-Putrescent Action of Salicylic Acid.—H. Kolbe and E. von Meyer.—The fact that salicylic acid, if heated above the boiling-point, splits up into carbolic acid and carbonic acid induced the authors to institute experiments on its antiseptic action. These experiments are not yet completed, but the results are in certain cases exceedingly satisfactory.

Les Mondes, Revue Hebdomadaire des Sciences.
No. 10, March 11, 1875.

Electrolytic Apparatus of M. Louis Maiche.—E. Girouard.—The author's iron-coke battery, as compared with that of Bunsen, consumes, for an equal amount of electricity, more than one-half less acid, and ten times less metal.

Ebullition of Sulphuric Acid.—A. Bobierre.—The ebullition of sulphuric acid can be conducted with as much regularity as that of water if a sufficient quantity of platinum is introduced into the retorts.

Speed of Light, and the Parallax of the Sun.—M. de Kericuff.

Hydrated Gelatinous Phosphate of Lime, and its Industrial Applications.—M. Claude Collas.—Dr. Sacc, of Neuchatel, has been engaged since 1866 in studying phosphate of lime, which he considers the most marvellous salt in nature. He found that it determines the putrid fermentation in animal matters, and the disagreggation of dead vegetable matter. He has since applied it as a mordant in dyeing. For this purpose the yarns or pieces are steeped in a solution of phosphate of lime in hydrochloric acid—more or less dilute, according to the judgment of the dyer—and then transferred to an alkaline dye-bath. The hydrated phosphate of lime precipitates colouring matters from their solutions, forming lakes.

The Electric Light in Workshops.—The electric light, so successfully introduced in the establishment of M. Hermann-Lachapelle, in the Faubourg Poissonière, is produced by means of the magneto-electric machine of Gramme, an engraving of which is appended.

No. 11, March 18, 1875.

Manufacture of Chlorine Gas.—M. D. Lantier proposes to treat anhydrous bichloride of copper with hydrochloric acid.

New Observations on the Nature of Alcoholic Fermentation.—M. Pasteur.—This paper is not adapted for abstraction. The charge brought against the late Baron Liebig ought to have been preferred in his lifetime.

NOTES AND QUERIES.

Colouring Spirit.—Can any of your readers give the best method of making burnt sugar for colouring spirit from 35 to 40 over proof, the spirit remaining perfectly bright? The more the sugar is burnt the weaker is its power of colouring. How can it be made stronger, and which is the best kind of sugar to use?—J. M. S.

Vitriol Chamber.—Would any of your correspondents to "Notes and Queries" kindly inform me what size chamber I should require for making 5 tons of sulphuric acid per week from iron pyrites, and the best form of burner for the pyrites, and the size, together with quantity of nitre required per ton of ore?—M. S.

Cement for Leather.—Can any correspondent kindly favour me with a receipt for a cement to fasten rubber to bend leather? Ordinary solutions of rubber in benzol or bisulphide of carbon are not sufficiently efficacious for my purpose.—G. C.

MEETINGS FOR THE WEEK.

Monday, 10th.—Royal Geographical, 8.30.
Tuesday 11th.—Civil Engineers, 8.
—— Photographic, 8.
—— Anthropological, 8.
Wednesday, 12th.—Society of Arts, 8.
—— Geological, 8.
Thursday, 13th.—Royal, 8.30.
—— Royal Society Club, 6.30.
—— London Institution, 7.
Friday, 14th.—Royal Institution, 8.
—— Quekett Club, 8.
—— Anthropological, 7.30.
—— Royal Astronomical, 8.

TO CORRESPONDENTS.

T. Farmer and Co.—*Dingler's Polyt. Journ.* and *Bulletin de la Soc. Chim. de Paris.*

A Constant Reader.—If the water contains no other ingredients but those you name it is not dangerous for dietetic purposes.

An Earnest Seeker after Truth.—The word "acid" is superfluous and has been merely introduced by a clerical error. You are, of course, aware that the term "ester" was applied by L. Gmelin to the compound ethers formed by oxygen acids.

THE CHEMICAL NEWS.

Vol. XXXI. No. 807.

ON THE DOUBLE SULPHATE OF SILVER AND ALUMINIUM.

By SERGIUS KERN, St. Petersburg.

By the following method the double salt of sulphates of silver and aluminium was formed, or as it may be named silver-alum :—

$$Al_2(SO_4)_3 + Ag_2SO_4 + 24H_2O;$$

this formula may be expressed :—

$$Ag_2(Al_2)(SO_4)_4 + 24H_2O.$$

The silver sulphate for the experiments was prepared by treating a concentrated solution of silver nitrate by sulphuric acid, sp. gr. 1·84. When the ebullition of the liquor commenced a very interesting phenomenon was observed, the temperature all the time rose and fell exactly between 90° and 95°. The solution being evaporated gave a white powder of Ag_2SO_4, soluble in 90 parts of water, and very easily soluble in caustic ammonia.

In a sand-bath on a small fire a solution of equivalent proportions of aluminium sulphate $[Al_2(SO_4)_3]$ and silver sulphate (Ag_2SO_4) yields a compound crystallising in octahedrical form, which proved to be silver-alum. With ammonium sulphate, $(NH_4)_2SO_4$, silver sulphate gives isomorphic crystals of silver-ammonium alum :—

$$(NH_4)_2SO_4 + Ag_2SO_4 + 24H_2O.$$

It must be mentioned that ammonium and aluminium silver alums are very unstable compounds, very easily decomposing into their original substances.

NOTE ON THE ANALYSIS OF CAMBRIDGE COPROLITE.

By JOHN HUGHES, F.C.S.

Text-books on analytical chemistry recommend that the original acid solution of a mineral phosphate should be evaporated to complete dryness, previous to the removal of the insoluble siliceous matters; but I believe this is not done by chemists in this country, who are extensively engaged in the examination of mineral phosphates. Some experiments which I have lately made certainly show that where the magnesia phosphate method is employed for the estimation of the phosphoric acid in materials similar to Cambridge coprolite, the result obtained is greatly influenced by the previous evaporation to dryness of the acid solution. The following analyses have been selected as examples.

2 grms. of finely ground sample were taken for each analysis, and dissolved in dilute hydrochoric acid with a few drops of strong nitric acid; but in one set of experiments the acid solution was evaporated to complete dryness over a low flame, and the residue dissolved in nitro-muriatic acid and water, gently warmed, and the insoluble siliceous matters filtered off; while in the other set of analyses the sand was filtered off as soon as the ground phosphate was sufficiently digested. In each case the filtrate from the sand was carefully neutralised, the lime precipitated by the addition of a known quantity of oxalate of ammonia in the presence of the necessary amount of citric acid and acetate of ammonia solutions, and the phosphoric acid determined by the well known magnesia method, care being taken to re-dissolve the magnesia phosphate precipitate after standing twelve hours (over night), and again precipitate it with ammonia, the precipitate being allowed to stand two hours more before final filtration.

The magnesia phosphate precipitate when burnt and weighed was boiled with strong hydrochloric acid and a little water, after which any residue in the form of silica was filtered off, burnt, and weighed.

In calculating the results, however, no notice was taken of this silica in order to show the great difference in the duplicate determinations of the phosphoric acid.

A and B were samples of Cambridge coprolite; C was a sample of Charleston phosphate, a phosphatic deposit which has been used with advantage instead of Cambridge coprolite for the manufacture of superphosphate.

	By the usual plan without evaporation of the original acid solution.			After evaporation to complete dryness of the original acid solution.		
	A	B	C	A	B	C
Insoluble siliceous matter	8·10	8·70	10·05	9·20	8·50	10·05
Lime	42·70	42·68	42·08	42·58	42·56	42·00
Phosphoric acid	26·90	26·85	27·00	25·30	25·40	26·20
Equal to tribasic phosphate of lime	58·72	58·61	58·94	55·23	55·45	57·19
Silica left in magnesia phosphate precipitate	2·05	1·65	0·95	0·30	0·50	trace

From these results it would appear probable that by evaporating the original acid solution of the phosphate to complete dryness, and especially if the residue be subsequently heated over a moderate flame, the fluoride of silicon is entirely driven off. While in the analyses in which the acid solution was not so evaporated to dryness, hydrated silicate of magnesia is thrown down with the genuine ammonia magnesia phosphate precipitate.

I have examined the white and peculiarly acid deposit, which from time to time has to be removed from the exhaust pipe in connection with the mixing pits, and find that if a small quantity be boiled with dilute hydrochloric acid, the gelatinous silica filtered off, and ammonia added in excess in the presence of some citric acid, no precipitate will be produced, but on addition of ammoniacal magnesia solution a semi-gelatinous precipitate immediately appears, and upon stirring the liquid, gradually settles down to the bottom of the beaker.

This precipitate readily dissolves in hydrochloric acid, but again appears when ammonia is added in excess, and it may, I think, be considered identical in composition with the hydrated silicate of magnesia I have above alluded to, and which I believe is thrown down with the true magnesia phosphate precipitate in all the ordinary analyses of Cambridge coprolite (or any similar phosphatic deposit) where the original acid solution has not been evaporated to complete dryness.

Lawes's Chemical Manure Works,
Deptford, May 6, 1875.

APPENDIX
ON THE
ANALYSIS OF CRUDE ANTHRACEN.

By GEORGE E. DAVIS and T. H. DAVIS.

Since writing our paper upon the above subject, Lück's process has been objected to by several chemists, on the ground that it gives too high results in consequence of incomplete oxidation. This has probably been resulting from a hasty oxidation, though in some cases, as we have indicated in our paper, too high a result may be sometimes obtained.

In order to overcome this difficulty, Messrs. Meister, Lucius, and Brüning have issued the following circular, which we shall do best by giving in its entirety :—

"The correctness of our method for the analysis of anthracen has been doubted, and it has been stated that, in consequence of incomplete oxidation, the percentage in certain samples has been found too high.

"There are impurities in some samples which strongly

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resist complete destruction by chromic acid, and we have endeavoured to find a method which will effect the complete oxidation and separation of these bodies so that nothing but pure anthrachinon remains.

"The method is as follows:—

"The first part of the process, *i.e.*, the solution of the sample in glacial acetic acid and gradual oxidation by chromic acid, as described in our former circular, remains the same. The anthrachinon thus obtained (washed with water only) is washed from the filter into a dish with 1 or 2 c.c. of caustic lye and boiled for five minutes with 1 c.c. of chameleon solution (permanganate of potash), the whole being well stirred. Should the red colour of the chameleon solution disappear, more is to be added until an excess is visible. After cooling, the liquid is rendered slightly acid by sulphuric acid, and a few crystals of oxalic acid added, which will effect the solution of the separated manganese compounds.

"The anthrachinon is then collected on a filter and washed, first with water, then with dilute alkali, again with water, and finally dried" *at* 100° *C.*

"The treatment of anthrachinon with permanganate solution occupies a short time only, and ensures the complete removal of all coal-tar impurities, anthrachinon alone remaining; we therefore consider the above treatment an essential perfection of our anthrachinon test.

"To avoid the errors involved in collecting on weighed filters, or filters counterpoised in the ordinary way, the following plan is recommended:—

"Two filters of equal size are selected and folded; the point, or cone, of one is cut off, so that, when folded together, the point of the inner projects through the cut part of the outer one to the extent of about half an inch; the two filters are then counterpoised exactly in a delicate balance, by cutting off small portions with scissors, and then folded together. The solution to be filtered is passed through both filters; after washing and drying, the inner filter, containing the anthrachinon, is placed in one pan of the balance, and the outer one in the other, adding weights till the counterpoise is perfect.

"The advantages of this method are, that it obviates errors—(1) from solution of the substance of the paper; (2) from scraping off some of the filter with the knife; and (3) from unequal absorption of moisture while weighing."

In adding this appendix to our paper, we may state that we have not made a trial of the improvements; we hope to do so shortly upon the dark green hydrocarbon, which we have found it so difficult to oxidise with chromic acid. We give the appendix so that the readers of the Chemical News may be acquainted with the latest on anthracen analysis.

SINGULAR ANOMALY OF THE SESQUIOXIDE OF IRON AS PREPARED FROM METEORIC IRON.

By J. LAWRENCE SMITH, Louisville, Ky.

In my studies connected with the physical, chemical, and mineral characteristics of meteorites, several points of more or less importance have been observed which have as yet formed no part of my published observations on this class of bodies. One of these observations is, that the sesquioxide of iron, obtained in the result of the analysis of meteoric irons, is always decidedly affected by the magnet, although the temperature to which it may be heated prior to final weighing be but a moderate red-heat, only sufficient to furnish a certain constant weight. This phenomenon was at first attributed to small particles of organic matter from the filter, that may have caused the reduction of a minute portion of the sesquioxide to a lower oxidation. Still later I was led to suspect the presence of some new magnetic metal—a metal, however, closely allied to iron (other than cobalt and nickel, as the oxides of neither of these metals are attracted by the magnet, whether obtained from meteoric iron or from any other source).

Experiments were undertaken to discover such metal, if any existed, but without success, and there the matter rested with me for several years, and until I commenced the study of the Ovifak iron, on which I am now engaged, in developing such facts connected with it as convince me that it is of terrestrial and not celestial origin, the results of which investigation I hope, before long, to submit to the Academy.

The observation in connection with the sesquioxide of iron resulting from meteoric irons was applied to that from the Ovifak iron, and it was also found to be attracted by the magnet. This anomaly showing itself in two irons that I supposed to be of different origins, it was resolved to make a critical investigation of the sesquioxide of iron obtained from both celestial and terrestrial sources; and if what follows appears too much in detail for the examination of so simple an observation, it was, nevertheless, necessary, in order to eliminate, as far as possible, sources of error, and to arrive at correct results.

Materials, &c., used in the Experiments.

The irons experimented with were dissolved in a large excess of a mixture of equal parts of chlorhydric and nitric acids. The filters used were old cotton cloth (perfectly free from lint), stretched over a funnel; the quantity of iron used did not exceed 1 grm.; the filtration was rapid, and the washing very easy and thorough. Other filtrations were made in funnels, the necks of which were plugged with asbestos.

The heating was conducted in thin, glazed porcelain crucibles, of about 40 c.c. capacity, and the heat applied by a small Bunsen burner of 5 cubic feet capacity per hour, the top of the flame spreading over the bottom and one-half of the sides of the crucible, thus heating to redness 2 or 3 decigrammes very readily, the amount usually employed.

As for the magnet used, I would state that as sesquioxide of iron, in a strict sense, ranks among the magnetic compounds, yet this is only true when very powerful magnets are brought to bear upon it; so the magnet used in all the experiments was a feeble one,—a small horse-shoe magnet, capable of sustaining about 200 grms. when the two poles were connected, and, when used, one of the angles of one of the poles was brought near to the particles of oxide experimented with.

First Series of Experiments made with Pure Sesquioxide of Iron.

The first sesquioxide used was prepared from the purest commercial iron, dissolved in equal parts of chlorhydric and nitric acid, diluted, filtered, and precipitated by an excess of ammonia after filtration.

1. Dried at 110° C., crushed to fine particles, but not pulverised. The magnet, being brought within 1 m.m. of these particles, *would attract them feebly.*

2. The same heated to 250° C. still showed signs of magnetism.

3. Heated to 425° C. the magnetism entirely disappeared, or could only be made apparent upon the very smallest particles.

4. At red-heat the *magnetism had entirely disappeared*, whether the heat was continued for five or ten minutes only, or during several hours.

All the tests with the magnet were made when the heated oxide had cooled; and the same was done in all the experiments referred to in this paper.

The second sesquioxide of iron used was prepared from pure protosulphate oxidised by nitric acid, and precipitated by ammonia. This, when dried, heated, and tested in the same manner as in the former experiments, gave similar results, viz., that hydrated sesquioxide of iron was always slightly magnetic when dried at a low temperature (even at 50°); but at high temperatures, as red-heat, all magnetic property disappeared.

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The third sesquioxide of iron was prepared from hemical pure iron, of which I had a small quantity resented to me by Johnson and Matthey, of London, hat had been made with great care by Mathiessen. The esults of these experiments differed in no way from those ust detailed.

Second Series of Experiments, with Sesquioxide from Meteoric Iron.

I next took meteoric iron with which to prepare the sesquioxide, using irons from a variety of sources. Those experimented with were the Toluca, Cranbourne, Russel Gulch, Sevier Co., Robertson Co. irons, and the iron from the stony meteorite that fell at Parnallee. These irons were dissolved in the same way as the iron in the first series, viz., with a large excess of chlorhydric and nitric acids, in equal parts, and most of the excess of acid driven off over a water-bath. The solution was then diluted, filtered, and poured into a beaker of hot distilled water, to which had been previously added a large excess of ammonia. The precipitates were washed and dried precisely as in the first series, and oxides examined by the magnet. The following were the indications given by all the oxides, with but very slight difference in degree:—Dried at 110° C., sensibly magnetic when the magnet was brought nearly in contact with the fine particles. Heated to 190° C., magnetism exhibited was about the same; at 300° C., slightly increased; at 450°, decidedly magnetic—and at red-heat more strongly magnetic—particles, 2 or 3 m.m. in diameter, being attracted at some little distance. It made no essential difference if the red-heat was continued only for a few minutes or several hours.

It will be remarked, in this series of experiments, that the effect of heat was just the reverse of what occurred in the first series; for in those experiments what little magnetic property existed in the oxide as first prepared, disappeared entirely when the oxide was brought to a red-heat.

I would here remark that the sesquioxide, as usually prepared by me in the analysis of meteoric iron, differs somewhat from the above, the iron in solution being first precipitated by boiling with acetate of soda, and the subacetate of iron subsequently converted into oxide; but the oxide thus prepared still exhibits magnetic properties analogous to that formed by using an excess of ammonia.

From the above results, the question naturally arises as to what is the cause of the difference in the first and second series of experiments; for the conditions under which the oxides were formed are as nearly the same as it was possible to make them, and they were made side by side at the same time.

In the first part of this communication it was stated that I supposed it might be due to a new metal closely related to iron, but whose oxides were all attracted by the magnet: this idea was discarded after varied and careful experiments that failed to give any evidence of the correctness of such an assumption.

The only thing left for me to do was to look into the oxides of iron from meteoric iron, and see what impurities they contained, and ascertain if these impurities played any part in this magnetic anomaly. It is well known that when a solution of meteoric iron is precipitated by an excess of ammonia, the oxides of nickel and cobalt at first precipitated along with the sesquioxide will be redissolved, but only in part, leaving often from 1 to 3 per cent of these oxides mixed with the oxide of iron. It is further known that while nickel and cobalt can be very nearly separated from iron by means of the acetate of soda, still a sensible portion will be left in the precipitated oxide of iron; so much so, that when I aim at exceeding accuracy in this separation, the subacetate at first precipitated (after partial washing) is re-dissolved and reprecipitated by the acetate of soda, and this operation repeated a second and a third time. While there is nothing in the presence of the oxides of nickel and cobalt that would lead to any explanation of the phenomenon under discussion (for neither of these oxides is affected by the magnet), still I was determined to see what would be the condition of the oxide of iron prepared from meteoric iron after four re-solutions and re-precipitations by acetate of soda, finally converting the subacetate of iron into the sesquioxide by dissolving it in aqua regia, and precipitating by ammonia.

The sesquioxide thus prepared no longer possessed the properties of that indicated in the second series of experiments, but showed the same properties as the ordinary oxide of the first series, viz., not attracted by magnet after heating to redness.

It being evident that the minute quantity of the oxides of nickel and cobalt remaining in the sesquioxide, as prepared from meteoric iron, had something to do with the phenomenon under consideration, I was led to institute a third series of experiments, using the sesquioxide from ordinary iron.

Third Series of Experiments with Sesquioxide of Iron prepared from Pure Iron, mixed with Oxides of Nickel, Cobalt, and other Metals.

A quantity of a solution of the sesquioxide was prepared by dissolving pure iron in a mixture of equal parts of chlorhydric and nitric acids, and a portion of the solution equal to about a gramme of the metal used in each of the subsequent experiments, adding to the solution of iron a solution of the other metals in the same acids prior to precipitation by ammonia.

Some of the iron solution, without any admixture, was precipitated, and the sesquioxide examined as in Series 1st, and being satisfied that the pure oxide gave no indication of magnetic attraction, the experiments were proceeded with.

Exp. 1.—A solution of the mixed oxides of nickel and cobalt, as obtained from meteoric iron, was added to some of the above solution of iron (the nickel and cobalt oxides representing about 10 per cent of the iron) precipitated by large excess of ammonia, dried, and tested with magnet before and after heating to redness, and the magnetic results were just the same as if we had been experimenting with meteoric iron, detailed in Series 2nd. This experiment was frequently repeated, and always with the same result.

Exp. 2.—Same experiment as last, only using oxides of nickel and cobalt from ordinary sources; the results were the same, only not quite so marked.

Exp. 3.—Pure nickel oxide was used, with similar results.

Exp. 4.—Pure oxide of cobalt was used with similar results.

While the above experiments throw some light upon the subject, they in no way explain the phenomenon, for none of the oxides separately exhibit the magnetic property. I therefore continued the experiments, using other metals besides nickel and cobalt.

Exp. 5.—Ten per cent of copper, dissolved in nitric acid, was added to a portion of the solution representing a gramme of iron, and precipitated with an excess of ammonia. The oxide dried and heated as in the previous experiments. When tested with the magnet it gave indications similar to the oxide from meteoric iron, but less in degree. In subsequent analyses of this oxide, thus precipitated, it was found to contain nearly 3 per cent of oxide of copper.

Exps. 6, 7, 8, 9, and 10.—In these experiments oxides of manganese, gold, platinum, zinc, and cadmium, were employed as admixtures with the iron; but in all cases the precipitated oxides differed in no way from the pure oxide of iron; when tested by the magnet evincing no attraction after being heated to redness.

The above experiments embrace all that I have made up to the present time, and the results that are new may be summed up as follows:—

1. That artificial hydrated sesquioxide of iron, dried at low temperatures, is attracted feebly by the magnet, but loses this property at and below red-heat,

2. That sesquioxide, precipitated in the ordinary methods from solutions of meteoric iron, and dried at a low temperature, acts similarly to the ordinary oxide, but differs from it in that it becomes decidedly magnetic on being heated from 400° C. to a red-heat.
3. That the sesquioxide from ordinary iron, mixed with nickel or cobalt, or both, from whatever source, exhibit magnetic properties identical with that from meteoric iron.
4. That the sesquioxide of iron from meteoric iron, freed entirely from traces of nickel and cobalt, corresponds to the ordinary sesquioxide in its behaviour to the magnet.
5. That the sesquioxide made from iron mixed with copper resembles that from meteoric iron.
6. That the sesquioxide from iron mixed with manganese, gold, platinum, zinc, or calcium, differs in no way from the pure sesquioxide in its magnetic reaction.

A natural inquiry is—What is the cause of this change in the sesquioxide of iron when mixed with oxides of nickel, cobalt, or copper? Analyses of mixed oxides have thrown very little light on the subject; for by carefully reducing the oxides by hydrogen, analysing the mixed metals (that usually gave from 2 to 3 per cent of the copper, nickel, or cobalt), and, calculating on the basis of all the iron being sesquioxide, my analytical results and calculations never differed more than from 1 to 1½ m.grms. in 1 grm. of the oxide that was used, and this difference is within the limits of error, yet it corresponds to amount of from 2 to 3 per cent of Fe_3O_4 mixed with the sesquioxide. And in want of any better explanation, I must suppose that the presence of the small amount of oxides of these foreign metals causes a reduction of a minute quantity of the Fe_2O_3 to Fe_3O_4, although a bright red-heat, however long continued, will not increase the magnetic property of the oxide, it having received its maximum as soon as it arrives at a red-heat.*

* It has been suggested to me, by Prof. C. F. Chandler, that the nickel, cobalt, and copper oxides present may form, with the sesquioxide of iron, a magnetic oxide, thus:—$NiO+Fe_2O_3=(NiFe)_2O_4$. The suggestion is a reasonable one, and worthy of consideration.

NOTES UPON SUGAR ANALYSIS.

By G. C. STEWART, F.C.S.,
Greenock.

During the last few years I have devoted much attention to the subject of sugar analysis; besides making many chemical analyses of *raw* sugars, I have analysed a great number of samples of crushed or refined sugar, manufactured in different sugar refineries throughout the country. When sugar is so very cheap, and every inducement thus offered to promote adulteration, when a new class of men has been constituted to watch over the food of the country, there is need for special communications upon this most interesting and important subject. Sugar, as met with in commerce, may be composed of crystallisable and non-crystallisable sugars, soluble salts, moisture, peroxide of iron, and other organic matter of undefined composition. The following analyses must not be considered as typical of the various kinds of sugar, for all of them vary exceedingly, but they give a fair idea of the composition of the sugars passed through the market.

Per cent.

	Egyptian Crystals.	Java (damaged).	Trinidad.	Cuba.	Bahia.	Melado.	Pernambuco.	French Beet Sugar (fine).	German Beet Sugar (low).	Crystallised Refined Sugar.	Crushed Sugar (1st class).	Crushed Sugar (2nd class.)	Crushed Sugar (3rd class).	Crushed Sugar (4th class).	Refined Syrup.
Crystallisable sugar ..	98·616	90·529	71·049	93·681	83·586	62·576	90·685	96·968	82·112	99 388	95·282	92·171	89·941	85·607	50·540
Non-crystallisable sugar	0·701	4·062	16·000	0·391	5·762	12·365	4·688	0·016	0·336	traces	1·268	3·826	4·391	5·963	21·889
Extractive organic matter	0·192	2·369	6·009	0·802	2·516	2 489	0·445	*0·220	*4 445	—	—	0·041	0·381	0·584	4·571
Insoluble organic matter	0·001	0·065	0·124	0·665	0·138	0·056	0·059	0·003	0·015	—	—	—	—	—	—
Sand and clay	0·124	0·254	0·778	0·071	0·208	0·692	0·664	0·584	0·069	—	—	—	—	—	—
Soluble alkaline salts ..	0·130	1·283	1·263	0·963	0·750	0·859	0·424	0·315	6·364	0·031	0·187	0·581	0·758	1·698	2·934
Peroxide of iron	—	traces	traces	—	traces	traces	traces	traces	traces	—	—	traces	traces	traces	traces
Moisture	0·236	1·438	4·777	3·427	7·040	20·963	3·035	1·894	6·659	0·581	3·263	3·381	4·529	6·148	20·067
	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000
Crystallisable sugar, *obtainable*	97·265	80·052	48·734	88·475	74·074	45·916	83·877	95·377	49·956	—	—	—	—	—	—
	Degrees.														
Polarisation	98·830	91·060	71·561	94·164	84·063	62·761	90·863	97·158	82·513	99·795	95·548	92·348	90·341	86·000	51 001
	Per cent.														
Total insoluble matter ..	0·125	0·319	0·902	0·736	0·346	0·748	0·723	0·587	0·084	—	—	—	—	—	—
Total ash	0·254	1·537	2·041	1·034	0·958	1·551	1·088	0·899	6·433	0·031	0·187	0·581	0·758	1·698	2·934

Composition Directly Determined.

Per cent.

Organic matter	99·509	97·024	93·181	95·537	92·000	77·480	95·876	97·318	86·907	99 386	96·549	96·107	94·713	92·153	76·967
Moisture	0·236	1·438	4·777	3·427	7·040	20·963	3·035	1·894	6·659	0·581	3·263	3·381	4·529	6·148	20·067
Ash	0·254	1·537	2·041	1·034	0·958	1·551	1·088	0·899	6·433	0·031	0 187	0·581	0·758	1·698	2·934
	99·999	99·999	99·999	99·998	99·998	99·994	99·999	100·111	99·999	99·998	99·999	100·069	100·000	99·999	99·968

* Undetermined matter.

The Crystallisable Sugar is best estimated volumetrically by Fehling's method. It must first, however, be converted into grape sugar, by protracted ebullition with dilute acid. I always conduct this experiment over a steam-bath, closing the neck of the glass flask with a perforated caoutchouc cork, carrying a glass tube bent in an obtuse angle which leads to a Liebig's condenser (turned upwards); the evaporated water thus flows back into the flask. After all the crystallisable sugar has been converted into grape sugar, the free acid is then neutralised by running in a dilute solution of pure sodium carbonate, and when perfectly cold it is diluted with water to a known volume, and then titrated in the usual way. One hundred parts of grape sugar are equivalent to 95 parts of crystallisable sugar. The results are not so satisfactory, as the boiling with dilute acid may convert some of the grape sugar into caramel. In analysing sugars practically, the sum of the crystallisable sugar is, however, always found by difference, and is then quite reliable.

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Polarisation.—Frequently, recourse is had to the power which a solution of crystallisable sugar has of turning to the right the plane of polarised light. When, therefore, a liquid contains crystallisable sugar without any other substance possessing the same optical property, the quantity of sugar may be estimated by measuring the deviation which the liquid produces in the plane of polarisation. To apply this, the deviation must be known produced by a standard solution of pure crystallisable sugar; and from this we can readily calculate the deviation produced by any other standard solution of sugar the richness of which we wish to ascertain. Upon the theory of this optical method is constructed the *saccharimetre-soleil* of Duboscq and others.

The polarising saccharometer, as considered from a practical point of view, is an exceedingly simple instrument. Sugar refiners not accustomed to manipulate it would readily mistake it at first sight for a family telescope; but, in reality, it is constructed of three parts, two of which are fixed, the other movable. The latter tube, which is of standard dimensions, is destined to hold the sugar solution the richness of which we wish to ascertain. There is a little movable tube, or eye-piece, to which the eye is applied, and which may be worked out and in until the polariscope has been properly focussed. The latter should be set in such a position in the laboratory that the flame of a gas lamp will shine through the whole arrangement, including the sugar solution, and care should be exercised to have the apartment as dark as possible. A mechanical arrangement, or "button," serves to regulate the saccharometer—*i.e.*, to cause the zero of the scale to coincide with the indicator. Another large horizontal "button" renders the observed tint, or shade, uniform, while a third arrangement assists in changing the colour of the disc best suited to the eye of the operator. There is also a graduated scale which supplies information about the richness in crystallisable sugar of the solution which may be under examination.

Before beginning the experiment, obtain an argand lamp, and elevate it about 2 feet above the level of the laboratory bench. Secondly, cover it completely with a copper wrapper, in the side of which must be drilled a circular hole, corresponding exactly in size with the glass at the end of the polariscope. Now light the gas lamp, and trim the flame so that a circle of the yellow portion will be obtained in the brightest degree possible. Place the saccharometer close up to this, and in such a manner that the reflected light will traverse through it in an horizontal direction. Secondly, let a tube be filled with distilled water, and set it in the instrument in the place reserved for it, between the eye-piece and the object-glass; then let the polariscope be carefully worked into the focus which suits best the sight of the operator, and until a circular surface or disc is obtained, divided into two equal parts equally tinted or coloured, or two separate tints or colours parted from one another by a black line, which must appear well cut and quite perfect. If, as generally happens, the two half circles have not the same tint or shade, *i.e.*, they do not blend, then turn the large horizontal button from left to right, or right to left, until the tint of the two circles is perfectly identical, and until the eye can no longer discern any difference between them. Again, it is not enough that the two half circles should be of the same tint; it is, further, necessary that the experiment should be conducted with the greatest possible amount of accuracy, and that this tint of uniformity should be the most sensible one possible. Every analyst, in using the saccharometer, should find out the shade of colour best suited for his eyesight; he ought to adopt it in all his experiments, as it is not advisable to use a number of colours during polarisation. If, while looking through the saccharometer, we make the milled head turn, we shall perceive that the colour of the two half discs changes incessantly, and that they repeat after each half turn. Supposing that the operator stops the rotation when the two half discs are of a yellow tint, both of which should be identical, beginning from the instant the milled head is rotated very gently in the same direction, green follows yellow, blue, green, indigo-blue, and lastly violet-indigo. If we look attentively, we shall come upon a certain shade, for which the uniformity of tint at first established for the yellow no longer exists; we shall see a difference which we might not at first notice. The same experiment repeated many times, and on different days, allows us to verify the shade which presents a different tint, when with another colour we see the quality of tint is always the same. Now, such a shade for polarisation is the most suitable, and the operator ought always to remember it and adopt it as his starting-point. For the greater number of experimenters, the delicate shade is the violet-blue tint, which recalls the colour of the flower of the foxglove, and for others yellow, or some brilliant colour. The violet-blue possesses this advantage, that if, while looking at it, we turn the milled head of the saccharometer infinitely little, one of the semicircles passes suddenly to red, the other to green. Consequently, upon rotation, the operator instantly stops whenever uniformity of tint is established. Observe if the zero of the scale corresponds exactly with the indicator; if this coincidence be not perfect, then make it so, and the polariscope is adjusted.

Take out the tube of water, and substitute for it the tube containing the sugar solution. If, working by inversion, uniformity of tint no longer appears, re-establish by rotation and proceed as before. This done, note the mark on the scale to which the mark upon the indicator corresponds. If the saccharometer has been adjusted very accurately, the indicator should exactly register 100°, distilled water being 0°.

With regard to the preparation of the sugar solution, it is usually of such a strength that 16·35 grms. of pure crystallisable sugar are dissolved in 100 c.c. of distilled water. In polarising raw sugar solutions, it is best to precipitate the extractive organic matter from them, by the addition of a few drops of tri-plumbic acetate solution, and then pass the mixture through a filter of chemically pure animal charcoal. In this way, all traces of the lead salt are removed, which is absorbed by the charcoal, and the sugar solution is obtained as clear as water. In the case of beet-sugar solutions, the addition of the head is unnecessary, the charcoal filter being sufficient.

For beet sugars, molasses, syrups, or "sweet waters," the saccharometer answers admirably, the rapidity with which the results are obtained from it, together with its extreme accuracy, places it at the top of all other methods for the estimation of crystallisable sugar.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 6, 1875.

Professor ODLING, F.R.S., Vice-President, in the Chair.

AFTER the names of the visitors had been announced and the minutes of the previous meeting read and confirmed, the names of Messrs. A. A. Nesbit, W. H. Martin, C. T. Blanchard, B.A., G. Crampton, J. C. Butterfield, J. W. Swan, A. W. Blyth, R. Stellon, G. Purdie, Jun., and the Rev. W. J. J. Welch, M.A., were read for the first time. Messrs. William Mogford Hamlet, Henry Mitchell Hastings, H. S. Carpenter, Alfred Southall, and William Alexander Little were duly elected Fellows of the Society after their names had been read for the third time.

The first paper, "*On Andrewsite and Chalkosiderite*," was read by the author, Professor N. Story Maskelyne. This mineral, which is named after Professor Andrews, is found in Cornwall in globular forms of a dark green

colour, often associated with cuprite, and in habit singularly resembling wavellite. It occurs on gangue of ferruginous quartz, and in many respects resembles the well-known mineral dufrenite. It may be represented by the formula $2(2Fe_2P_2O_8+Fe_2H_2O_4)+CuH_2O_2$. The other mineral which accompanies Andrewsite in bright green crystals was found by comparison with specimens of old date in the British Museum to be identical with the chalkosiderite of Ullmann. This mineral, which was examined before the blowpipe by Ullmann (who found the copper and iron, but missed the phosphoric acid) has hitherto been erroneously placed by mineralogists with dufrenite. It occurs in clustered groups or sheaves of blunt striated prisms, the minute size and the rounded striated faces of which render accurate measurements exceedingly difficult. Its composition may be represented as—

$$2Fe_2P_2O_8+Fe_2H_6O_6+CuH_2O_2+4H_2O.$$

Professor Odling having thanked the author,

The Secretary read a communication from Dr. W. Flight entitled "*An Examination of Methods for Effecting the Quantitative Separation of Iron Sesquioxide, Alumina, and Phosphoric Acid.*" After reviewing the various processes for the separation of phosphoric acid from alumina and also from iron, and giving the details of various modifications of some of these processes which he had tried, the author described the process ultimately adopted, which consisted in boiling the solution containing the alumina, iron, and phosphoric acid, and which should not be very acid, for two or three hours with excess of sodium hyposulphite. All the alumina with a part of the phosphoric acid was precipitated, whilst the iron with the rest of the phosphoric acid remained in solution. From this solution the iron could at once be precipitated by ammonic hydric sulphide, and converted into ferric oxide, whilst the alumina and phosphoric acid in the precipitate were separated by treatment with excess of caustic soda and barium chloride, which precipitates the phosphoric acid in combination with the barium, whilst the alumina remains in solution. In washing the precipitate a few drops of soda solution must be added to the wash-water, as the phosphate is decomposed by pure water. This phosphate was then decomposed by sulphuric acid, and the phosphoric acid determined in the usual way. In conclusion, the author noticed the decomposition which solution of sodium phosphate undergoes in contact with glass or porcelain from its removing the silica from it, and also a notice of some experiments made with a view to convert ortho- into meta-phosphoric acid.

The Chairman said they were much indebted to Dr. Flight for this process, which, in his hands, at least, gave such satisfactory results.

Mr. Warington said he was able to confirm many of the statements of the author, especially that phosphoric acid was not completely precipitated by magnesia when alumina was present. On the other hand, with iron the separation was perfect. One point of especial interest to him, as he had paid some attention to the decomposition of calcium phosphate by water, was the decomposition of barium phosphate under similar circumstances. There was, however, this difference, that the latter appeared to be more readily attaked, for cold water had a perceptible action on it, whilst the former was only decomposed by hot water.

Dr. Debus understood Dr. Flight to state that Sonnenschein's molybdic acid method in the presence of alumina and iron, although accurate enough for ordinary purposes, was not so for scientific purposes. He, however, gave no comparison of results obtained by the two processes. As far as he was himself concerned, he had always obtained excellent results by this method.

Professor Maskelyne, in reply, said his own impression was that the barium phosphate was slightly soluble in pure water, and was not decomposed by it. With regard to Sonnenschein's method, the objection to it was that in this particular instance it was necessary to determine phosphoric acid, alumina, ferric and ferrous oxide, and the use of nitric acid, required for the molybdic acid process, necessarily complicated the matter of the determination of the ferrous oxide.

A paper "*On Sodium Ethyl-Thio-Sulphate,*" by Mr. W. Ramsay, was then read. The author finds that the precipitates obtained on adding silver nitrate or a mercuric salt to sodium ethyl-thio-sulphate are very unstable, being readily decomposed, with formation of metallic sulphides; also, that when the sodium salt is heated with phosphoric chloride, phosphoric oxychloride and ethyl disulphide are produced, but no sulphuryl chloride, as stated by Spring. At the same time, a small quantity of a brown oil is formed, which is freely soluble in alcohol and ether with a beautiful crimson colour, but only sparingly soluble in water.

Mr. John Williams then read a paper "*On a Milligrade Thermometric Scale.*" After pointing out the disadvantages attending the use of the centigrade scale, arising from the size of the divisions, and the comparatively high temperature of the zero-point, necessitating the use of the minus sign, the author suggested the substitution of the freezing- and boiling-points of mercury for those of water, fixing the one at −40° C. and the other at 360° C., and dividing the scale into 1000 parts. The freezing-point of water would then be 100°, and its boiling-point 350°, whilst 5 milligrade degrees would be equal to 2° C.

Dr. Odling remarked that when the centigrade thermometer first began to come into use in this country, the objections made to it were the largeness of the degrees and the high zero-point. It possessed the great advantage, however, that the determination of the melting-point and boiling-point of water could be made easily and accurately. The enormous amount of literature and of work in which the centigrade was used would be a great obstacle to the introduction of Mr. Williams's milligrade scale.

The last paper was "*On a New Method of Supporting Crucibles in Gas-Furnaces,*" by Mr. C. Griffin. In the author's gas-furnace, a description of which was communicated to the Society in 1870, the perforated plumbago cylinder, and the trivet-grate on which the crucible is supported, are liable to break when white-hot, occasionally giving much trouble; moreover, the latter has the disadvantage of interfering with the direct action of the flame on the crucible. This, however, is entirely obviated by the new burner, in which a space is left round the central jet, which has fitted over it an atmopyre similar to those used in Hofmann's combustion-furnace. The bottom of the crucible rests on this, and the plumbago cylinder is thus relieved of all pressure. These new burners are very economical and of great power, a small one, burning 20 feet of gas per hour, being capable of melting half-a-pound of cast-iron in thirty-five minutes; or of heating a muffle, 5 inches long and 3 wide, to a temperature sufficiently high for assaying. Several varieties of the furnace were exhibited, one of which was in action.

Dr. Odling having thanked the author for this addition to the many pieces of apparatus which he and his father had introduced to the notice of chemists, the meeting was adjourned until Thursday, May 20, when the following papers will be read:—

(1.) "Note on Milk in Health and Disease," by A. Smee, jun.; (2.) "The Effects of Pressure and Cold upon the Gaseous Products of the Distillation of Carbonaceous Shales," by J. J. Coleman; (3.) "On some Nova Scotian Triassic Trap Minerals," by Professor How; (4.) "On some Points in the Examination of Waters by the Ammonia Method," by W. H. Deering; (5.) "On the Agricultural Chemistry of Tea Plantations of India," by D. Campbell Brown; (6.) "On the Structure and Composition of Certain Pseudomorphic Crystals having the Form of Orthoclase," by J. A. Phillips; (7.) "On Nitrosyl Bromide and on Sulphur Bromide," by M. M. P. Muir.

PHYSICAL SOCIETY.

May 8th, 1875.

Professor GLADSTONE, F.R.S., President, in the Chair.

Mr. CROOKES, F.R.S., exhibited and described some very important experiments "*On Attraction and Repulsion Resulting from Radiation*," which he has recently submitted to the Royal Society, and of which an account has already been given in the CHEMICAL NEWS (vol. xxxi., p. 189). It is unnecessary, therefore, to describe them at length, but it may be pointed out that one of the most beautiful of the instruments is one which Mr. Crookes calls a radiometer. It consists of four arms suspended on a steel point resting in a cup, so that it is capable of revolving horizontally. To the extremity of each arm is fastened a thin disc of pith, lamp-blacked on one side so that the black and white faces alternate. The whole is enclosed in a glass globe, which is then exhausted as perfectly as possible, and hermetically sealed. Several of these instruments varying in delicacy were exhibited, and experiments made showing the influence of light and heat of different degrees of refrangibility, and in proof of the law of inverse squares, &c.

The PRESIDENT, in expressing the cordial thanks of the Society, referred to Mr. Crookes's statement that the repulsion was proportional to the length of the vibrations, and asked whether at the red end of the spectrum there was an abrupt termination of the action, and a gradual diminution towards the ultra-violet.

Mr. WALENN inquired as to the action of the magnet, and of different axes of crystals in causing repulsion.

Prof. WOODWARD made some observations with reference to the manipulation.

Prof. GUTHRIE observed that in looking back along the glorious course of physical research upon those great land-marks of discovery which serve alike as consummations of past, and as points of departure for future progress we involuntarily classify them in two great categories. Of many the value far outweighs the merit. In these, by some stroke of fortune almost akin to blind chance, or by some flash of genius for which there is scarcely another name than inspiration, a whole vista of the hitherto unknown is displayed. In others a result of apparently trifling significance is the outcome of years of the most patient labours. I venture to express my own very strong conviction that Mr. Crookes's discovery has, almost in an unparalleled degree, both elements of greatness. Years of labour performed with infinite faith in the truthfulness of nature, with steadfastness, forethought, and perhaps unique manipulative skill, have resulted in a discovery, to find the counterpart of which in interest and importance we should have to look closely into, and far down, the records of the past. Grateful as all scientific men must be for the great gift of knowledge which they have received at Mr. Crookes's hands, that gratitude is much enhanced by the modesty so becoming his genius and good fortune which has restrained him from premature theorisation, and which has decided him, despite the speculations with which his brain must have been teeming, to permit these great facts to speak in the unsophisticated language of experiment.

Mr. CROOKES stated, in reply to Dr. Gladstone's question, that the opacity of the glass envelope of the radiometer for extreme rays must be taken into account in considering the action of the rays of different refrangibility, and further, that the increased effect due to red light may have been in part due to the concentration of rays of low refrangibility, which attends the use of glass prisms. A diffraction spectrum might give a different result. He added that when a ray falls on a surface capable of motion which reflects it very little work is done, but if the surface quenches the ray motion is produced. He then thanked Prof. Guthrie for his kindly remarks.

Prof. CORNU, of the Ecole Polytechnique, described his recent experiments on the determination of the velocity of light. He gave an account of the method of Foucault, and exhibited the complete apparatus including the arrangement of mirrors for multiplying the distance through which the luminous ray passed between the two reflections from the revolving mirror. He described the toothed wheel of Fizeau, and the improvements which he had himself made in his own determinations by this method. He found that it was impossible to give an uniform motion to the toothed wheel, and therefore adopted an electrical registering apparatus to mark the increase of its velocity, an electric signal enabling the observer to point out the instant at which the right velocity is obtained. Another very important improvement is the substitution of a pair of observations of the return rays for the single observation of a total extinction. Prof. Cornu's most recent determination was made in the summer of 1874, the two stations being the Paris Observatory and the Tower of Montthéry, 14½ miles apart. A mean of 508 experiments gave 300,400 kilometres, or 186,660 miles per second.

Prof. ADAMS, Vice-President, mentioned that M. Cornu had contributed in no small measure to the success which had attended the formation in France of a Society closely corresponding to our British Association, and assured him that the Physical Society felt grateful for his presence, as he could well understand the difficulty with which the early days of such a Society were beset.

Prof. CORNU stated, in answer to a question of Prof. G. C. Foster, that he objected to the revolving mirror method, because the distance to be traversed by the light was very small, and because the path of the ray lay through a vortex of air produced by the rapid revolution of the mirror.

SOCIETY OF PUBLIC ANALYSTS.

THE SALE OF FOOD AND DRUGS BILL.

WE had indulged the hope that in any further reference to this Bill we should have been able to speak of it as a completed measure, but so wearily does it "drag its slow length along" that—though it was read a second time on February 19th, and committed on March 4th—we have reached the middle of May, and it is still in an unfinished state. Seldom, we should imagine, has such a small Bill led to so much discussion, or been subjected to so many alterations at the hands of its authors.

In our issue of April 23rd we noticed the amendments which had been carried on the first five clauses. On the 6th inst. the House devoted considerable time to the discussion of the Bill, and numerous amendments were disposed of, most of them being either withdrawn or negatived.

Mr. SANDFORD once more recited the thrice-told tale about the incompetency of the Public Analysts, and was (as might have been expected) forcibly, if not ably, supported by Sir Henry W. Peek.

As an antidote to this "incompetency" on the part of scientific men, of which lawyers and tea dealers are obviously the best judges, two remedies were proposed:—The one of the Hon. Member for Maldon was simply to make the county magistrates the appointing bodies in all cases. This proposal is exceedingly simple, but the House seemed to think that its simplicity would be combined with utter futility.

Sir HENRY WILLIAM PEEK proposed a bolder and more practical course. He would ensure the impossibility of there being any incompetent Public Analysts by the mild expedient of abolishing Public Analysts altogether. It need hardly be said that in an assembly of intelligent men, anxious in the main to do justice, the brilliant suggestion of the Hon. Baronet who represents the dual constituency of Mid-Surrey and Mincing Lane was not adopted.

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In Clause 9 Dr. Lyon Playfair proposed an amendment, for the purpose of providing that a Public Analyst should not be at the same time engaged in the business of buying or selling articles of food or drugs. This was much debated, and though little was said, or can be said, against the principle of the amendment, it was fairly urged that—in some appointments already made—pharmaceutical chemists had proved to be good analysts as well, and that it would be unjust to deprive them of their appointments. Eventually the amendment was withdrawn, but on the understanding that Mr. Sclater-Booth would add words when bringing the Bill up, on report, to meet Dr. Playfair's views.

In Clause 16, on the motion of Dr. Cameron, the penalty for refusing to sell articles for the purpose of analysis was increased from £5 to £10.

In Clause 18 a provision was inserted directing local authorities to make an annual report to the Local Government Board of the number of articles analysed in their respective districts.

The Bill was again under discussion on Tuesday last, the 11th inst., the following being the net result of a debate of some length:—

In cases of disputed analyses, where the defendant desires a further examination of a sample to be made, it shall be competent for the Justices hearing the case to direct that the article be referred to be analysed by "Chemical Officers in the employment of the Inland Revenue."

The manifestly unfair suggestion that the certificates of such officers should be considered "final" was, of course, repudiated by the Government; and whether a chemist be an *employe* in Somerset House, or an Analyst in independent practice, he will equally be liable to be called on to give the figures of his analysis on oath, and submit himself to cross-examination.

A meeting of the Council was held at the Cannon Street Hotel on Wednesday, the 12th inst., when (in accordance with an instruction of the General Meeting of the 5th inst.) the question of some analyses of coffee recently made by the Analyst for Northamptonshire was fully discussed, and the following resolution was passed:—"That the proceedings in connection with some recent analyses of coffee made by Mr. Joseph Young, of Leicester,—resulting in the prosecution for adulteration of a number of persons, afterwards admitted to be innocent,—having been laid before the Council, together with Mr. Young's written explanation, the Council are of opinion that such explanation is eminently unsatisfactory, and they regret that Mr. Young should have certified to adulteration on such insufficient grounds."

NOTICES OF BOOKS.

Third Annual Report of the Director of the Imperial Mint, Osaka, Japan, for the Year ending July 31st, 1874. Hiogo: "Hiogo News" Office.

This report is mainly interesting from the light it throws upon the progress of chemistry and metallurgy in Japan. The chemists, engineers, assayers, engravers, &c., appear still to be all Englishmen. From the special memorandum of the chemist, Mr. Gowland, we gather some interesting facts as to Japanese copper. The following analysis is given to show the composition of an average crude copper from Washiu:—

Copper	98·940
Lead	trace
Sulphur	0·947
Iron	0·101
Silver	trace
Arsenic	trace
Antimony	absent
	99·988

A sample from Hishiu is remarkable for the abnormal amount of lead:—

Copper	58·872
Lead	39·283
Silver	0·185
Iron	0·083
Sulphur	1·635
Arsenic	faint trace
Antimony	absent
	100·058

All the samples of copper examined were remarkably free from the specially injurious metals, antimony and arsenic, antimony being present only in one specimen, and then only in faint traces, whilst the maximum amount of arsenic only reached 0·057 per cent, and in thirty-one cases (out of 38) it was either absent altogether, or the merest traces only were found." Mr. Gowland very justly remarks that the copper of Japan, when properly selected and refined, should be of high value for electro-telegraphic purposes, where freedom from arsenic and antimony is especially required, these metals when present reducing the electro conductivity to a serious extent."

Many of the native copper ores are argentiferous, and silver is present in the metal in more than traces, though the greater proportion of the precious metal is removed by a "crude process of liquation with lead."

An ingot of so-called native gold was received by the department for examination. It consisted of:—

Gold	78·50
Silver	12·25
Lead	8·05

Copper, with smaller proportions of arsenic and antimony, were also present. The metal was "of a dull, dirty greenish-yellow colour, excessively brittle, and with a fracture almost earthy, of the colour of that of Muntz's metal. From this ingot the gold and silver were successfully extracted in a state fit for coinage by Miller's chlorine process.

Plumbago of good quality is found at Satsuma. A sample analysed contained 88·09 carbon, and 11·01 of a pale grey ash.

Our countrymen in the service of the Imperial Japanese Mint appear to be decidedly the right men in the right place, and as such we wish them every success.

Practical Guide to the Determination of Minerals by the Blowpipe. By Dr. C. W. C. Fuchs. Translated and Edited by T. W. Danby. London: Field and Tuer. Philadelphia: Claxton, Remsen, and Haffelfinger.

This work, as the author informs us in his preface, consists of two parts, the one treating of the determination of minerals by the blowpipe; the other explaining means of determining crystallised specimens, depending upon their physical characteristics. The translator's object has been "to present Prof. Fuchs's tractate so that it shall be in the highest degree serviceable, not only to the student of mineralogical science, but also to the less purely scientific investigator, in the mine or the quarry." In place of the second part of the original German work "is appended a table, showing the hardness, specific gravity, and crystallographic system of each species, so far as these latter are determined beyond question."

The editor points out, among the obstacles which present themselves to any one either writing or reading a work of this nature, "the perplexities of chemical nomenclature and notation, and the bewildering abundance of synonyms." The latter point, which has recently been the subject of some correspondence in our columns, he pronounces "a disadvantage well nigh as grievous as that due to vagaries in chemical notation." Valuable, or rather indispensable as formulæ are in works dealing with chemical theories, their legitimate place in manuals of analysis is very small, and we regret the manner in which they are too often needlessly paraded.

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The following hint may prove useful: "When the quantity of substance to be reduced is very small, the end of a wooden lucifer match will be found a convenient support. The end of the match is smeared with sodium carbonate, and charred by careful exposure to the flame. A small charcoal point coated with soda is thus obtained, the moistened assay can be readily affixed to this, and held in any required position in the flame."

Of course a treatise of such brief compass—some eighty pages—cannot be expected to "supersede or compete with" such works as that of Plattner. But within the limits which the author and the translator point out, it will, we believe, be found useful by students and travellers interested in mineralogy.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 14, April 12, 1875.

New Body Found in the Urine after the Ingestion of Chloral Hydrate.—MM. Musculus and de Mermé.—Foreign substances introduced into the human organism are rejected in states which may be divided into three groups:—1. Bodies which pass unaltered through the system, such as creatin, acetamid, &c., and are found unchanged in the urine. 2. Bodies which are decomposed, and whose decomposition products are found in the blood, the saliva, and the urine, such as leucin and glycocoll, which yield urea. 3. Bodies which combine chemically with some product of the organism, and thus pass into the urine. The type of this group is benzoic acid, which combines with glycocoll, and is eliminated as hippuric acid. In the urine of dogs poisoned with chloral hydrate, Feltz and Ritter have recently discovered chloral, sugar, and another organic substance precipitable by the basic acetate of lead. It is an acid which forms stellar groups of crystals resembling those of tyrosin, and containing—

Carbon	31·60
Hydrogen	4·36
Chlorine	26·70

It is not expelled from its salts by acetic acid. At the boiling-point it reduces alkaline solutions of copper and bismuth, and salts of silver, and decolourises sulphate of indigo. It turns the plane of polarisation to the left. The authors hold that chloral should rank in the third group with benzoic acid, and propose for the acid found the provisional name of urochloralic.

Inaccuracy of Determinations of Nitrogen in Manures.—A. Bobierre.

Calorimetric Study on the Carbides of Iron and of Manganese.—MM. Troost and Hautefeuille.—These experiments show—That carburetted irons are formed with absorption of heat, if we set out from their elements. This fact classifies cast-irons in the category of the explosives, or in that of solutions. That manganese and carbon combine with the disengagement of much heat. In this respect the carbide of manganese, Mn_3C, is comparable to the most stable compounds of mineral chemistry. The combinations of iron, manganese, and carbon are also attended with great disengagement of heat. The ferro-manganeses, therefore, are true compounds.

Matters Optically Active, and Distinct from Glucose, Normally Present in Wine.—M. A. Béchamp.—Wine decolourised, suitably concentrated, and freed from tartar, yields a solution which, in some cases, turns the plane of polarisation to the left, in some to the right, and in others occasions no deviation. When it turns to the left it is because the quantity of non-crystalline sugar is more than sufficient to compensate for the effect of the dextro-gyratory matters. When it turns to the right, the quantity of lævulose is too small to compensate the action of the dextro-gyratory matters, or else it has been entirely destroyed. If there is no deviation, the dextro-gyratory matters are exactly compensated by the lævulose, or all the active matters have disappeared. Neither the saccharimeter nor the cupro-potassic reagent are safe processes for the determination of the sugar in wines. Hence, fermentation alone appears trustworthy.

Preparation of Perchlorated Ethylen.—E. Bourgoin.—The process of Geuther does not give satisfactory results. The following procedure is simple, easy, and successful:—Dissolve with the aid of heat sesquichloride of carbon in double its weight of commercial aniline. Heat the mixture in a retort to 170°, and collect the product which distils slowly into a receiver, which scarcely requires to be cooled. The action commences immediately, and the liquid takes rapidly a fine red colour. A quantity of 500 grms. requires about six hours. The distillate is perchlorinated ethylen, holding in solution aniline and sesquichloride of carbon. To remove the latter body, an equal weight of aniline is added, and the whole is distilled between 130° and 145°. By means of washing with dilute sulphuric acid the residue of aniline is easily removed. All that is requisite is to dry the product over fused chloride of calcium.

Amount of Heat Liberated in the Decomposition of the Bromides of Certain Acids of the Fatty Series by Water.—M. W. Louguinine.—Not suitable for abstraction.

Determination of Carbonic Acid in the Air, on board the Balloon "Zenith."—M. G. Tissandier.—At the altitude of 800 to 890 metres, at the temperature of 0°, and the pressure of 760 m.m., the amount of carbonic acid in 10,000 parts was 2·40. At 1000 metres the proportion was 3·00. These differences are within the limits of variation of experiments made on the surface of the earth.

Central-Blatt fur Agrikultur Chemie, Heft 2, February, 1875.

Formation of Nitrous Acid and Peroxide of Hydrogen in Nature.—Prof. L. Carius.—From *Liebig's Annalen*, 174, pp. 1 and 31.

Temperature of the Greatest Density of Water.—F. Exner.—The mean result obtained by the author is 3·945, which agrees with Joule and Playfair's determination.

Regulating the Amount of Water in Cultivated Lands.—Dr. A. Schleh.—The author finds that a soil when rolled or otherwise solidified by pressure, loses by far more water than one whose upper surface is loosened.

Phosphate of Lime of Ciply, in Belgium.—Ninoit.—The nodules contain, on the average,—

Water	25·55
Organic matter	
Carbonic acid	
Sand and clay	1·30
Phosphoric acid	20·35
Sulphuric acid	0·12
Chlorine	0·25
Fluor	0·18
Lime	51·60
Oxide of iron	0·90

The grey limestone, interspersed with small brown granules, gave—

Loss on ignition	31·00
Sand and clay	2·10
Phosphoric acid	11·13
Lime	54·00
Chlorine..	—
Oxide of iron..	1·16
Not determined, and loss ..	0·67

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Analysis of Buffalo's Bones.—J. W. Mallet.—From the Chemical News.

Comparative Experiments with Peruvian Guano and Mono-Phospho-Guano.—Faron.—The Peruvian guano gave a greater weight, both of corn and straw. The soil is described as poor and calcareous. The composition of the mono-phospho-guano is not given.

Comparative Manurial Experiments on the Experimental Field at Giessen.—Prof. Thaer.—The manures tried were—(1) Ohlendorff's dissolved guano, guaranteed to contain "9 to 10 per cent easily soluble phosphoric acid," and the same amount of "nitrogen secured against evaporation." (2) Steamed bone-dust, from Griesheim's works, at Frankfurt, guaranteed as containing 20 to 22 per cent of phosphoric acid. A plot manured with 100 lbs. guano yielded a heavier crop than an equal plot manured with 200 lbs. bone-dust.

Investigations on the Production of Heat, and the Transformation of Matter in Animals.—Dr. H. Senator.

Source of the Acid in the Gastric Juice.—R. Maly.—From *Liebig's Annalen*, 173, p. 227,

Pancreatic Peptones.—Dr. B. Kistiakowsky.

Consumption of Food, and the Productivity of German and French Rabbits.—Dr. H. Weiske.

Influence of the Cultivation of Meadows on the Nutritive Value of Hay.—"E."

Feeding Calves.—H. Bertshinger.

Evaporation from Certain Organs of Plants.—Dr. A. Schleh.—The author shows that a considerable amount of water escapes from the roots of plants.

What Degree of Heat can Seed-Wheat bear without becoming Incapable of Germination?—F. Krasan.—If moisture has been previously expelled, the temperature required for the complete destruction of the germinating power is higher than 100°.

Occurrence of Alumina in Cryptogamous Plants.—A. H. Church.—From the Chemical News.

Comparative Cultivation of Barley and Rye.—Dr. L. Wittmarch, Prof. F. Körnicke, Dr. Crampe, &c.

How Thickly, and in what Manner Rye should be Sown.—E. Schwarz.

Attempt at Acclimatising Media Sativa on the Sandy Soils of the Coast of Flanders.—J. Landron.

Is it Possible to Produce a Beet-Seed which shall both yield a Heavy Crop and a High Percentage of Sugar?

Experiments with Beet-Root in Ireland.—Dr. Cameron.—From a pamphlet by the author.

Intensity of the Inversion of Sugar by various Mineral and Organic Acids.—Dr. Arno Behr.—It is well known that dextro-rotatory cane-sugar is more or less readily inverted under the influence of certain acids, becomes converted into a mixture of dextro-rotatory glucose and lævo-rotatory fructose. The author has made a series of comparative experiments on the action of various acids upon cane-sugar. The principal points examined were the respective proportions of sugar and acid; the degree of concentration; the time of action; the temperature; and the chemical nature of the acid. Each of these points was varied in turn in the several series of experiments, whilst the others were kept constant. All the acids examined produced inversion, namely, the acetic, butyric, isobutyric, malic, citric, succinic, formic, lactic, tartaric, oxalic, phosphoric, sulphuric, hydrochloric, and nitric. The action is very trifling near the temperature of 0°, rises not proportionately to the temperature, and becomes suddenly very powerful at a temperature lying between narrow limits, which vary according to the nature of the acid. According to their degree of action at common temperatures, the acids may be arranged in a series in which nitric and hydrochloric acids appear the most powerful, and the volatile acids of the fatty series (except formic acid) the least so. A similar series is found by taking the temperatures at which the comparably strong action of the acids begins. For the acid washing-water in Scheibler's process acetic acid is most suitable for beet-root, and sulphuric for Colonial sugars. No simple connection was found between the chemical nature of the acid and the intensity of the inversion.

Use of Zinc in Breweries.—Prof. J. Nessler.—Zinc is slowly acted upon by worts and by decoction of hops.

Coagulation of Milk.—Prof. Segelke.

Peculiar Goat's Milk.—Dr. G. Schröder.

Preservation of Articles of Food.—Prof. A. Almen, Tellier, and Poggiale.

Smoked Meats.—Prof. J. Nessler.—The author shows that the real preservative of smoked meats is dryness.

Need of Bacteria for Oxygen.—Prof. F. Cohn.—The author holds that the bacteria found in Dr. Bastian's well known experiment were pre-existent in the cheese employed as germs, which the boiling was not sufficiently prolonged to destroy.

Gazzetta Chimica Italiana, Anno v., Fascicolo 1 and 2, 1875.

Notice of Two New Derivatives of Phloretic Acid.—W. Kœner and P. Corbetta.—The authors describe methyl- and ethyl-phloretic acids, and their oxidation-products.

Origin of the Sulphides and Hyposulphites found in Sulphuretted Springs.—Prof. Egidio Pollacci.—The author concludes that the alkaline and alkaline-earthy sulphides found in nature, and especially in sulphuretted waters, instead of being derived from the reduction of sulphates, as was believed till lately, are produced by the action of hydrosulphuric acid upon carbonates and silicates. These sulphides, then, attracting oxygen from the air, are converted first into polysulphides, and then into hyposulphites. The opalescence of the sulphur-waters of the French Pyrenees is mainly due to silicic acid, derived from the action of carbonic or hydro-sulphuric acid upon the silicates in the water.

Researches on Certain Derivatives of Thymol, Natural and Synthetic.—E. Paterno.—The bodies examined are the acetylic derivative of thymol,—

$$C_{10}H_{13}OC_2H_3O;$$

the methylic ether, $C_{10}H_{13}OCH_3$; the ethylenic derivative; the sulph-acid of the methylic ether, with its barytic, plumbic, and potassic salts. Of the derivatives of cymen-thymol, the author has examined the acetylic derivative; the methylic and ethylenic ethers; the sulph-acid of the methylic ether, with its barytic salt; and the sulph-acid of cymen-thymol.

Paratoluylic Nitrile and some of its Derivatives.—E. Paterno and P. Spica.—The authors, by passing a current of sulphuretted hydrogen into the alcoholic solution of paratoluylic nitrile, obtain paratoluylic sulph-amide.

Glucosate of Copper.—Dr. M. Fileti.—The compound contains 47·36 per cent of copper, and may be expressed by the formula $C_6H_6O_6Cu_3{}_2H_2O$.

Experiments on the Production of Cymen-Carbonic Acid.—E. Paterno and M. Fileti.—The authors have obtained a substance which they consider to be the amide of cymen-carbonic acid.

Supposed Emission of Carbonic Acid from the Roots of Plants.—M. Mercadante and E. Colosi.—The authors conclude that the evolution of carbonic acid from roots is not an admissible fact.

Moniteur Scientifique, du Dr. Quesneville, February, 1875.

Copper-Ruby as a Colour for Glass.—M. Paul Ebell.—A most important treatise, but unfit for abstraction.

Relations of Fluorescence between Chrysen and Pyren.—H. Morton.—Translated from the *Transactions of the Stevens's Institute of Technology.*

Analysis of Industrial Products.—M. A. G. Pouchet.—A paper on alkalimetry.

Chemical Products at the Exhibition of Vienna.—M. E. Kopp.—An account of the oily and fatty bodies, soaps, &c.

Remarks on the Properties of Nitrate of Methyl.—M. C. Girard.—This paper has already appeared in the CHEMICAL NEWS.

Modification of Rivot's Process for the Determination of Copper as Sulphocyanide.—M. A. Ferent.—Noticed elsewhere.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved process for treating blood for the manufacture of manure. Thomas Myerson, St. John's Street, Clerkenwell, Middlesex. June 30, 1874.—No. 2273. The feature of novelty in this invention consists in mixing chloride of sodium and alum with blood, and drying in the common atmosphere, thereby retaining the natural proportions of nitrogen contained in the blood for the manufacture of manure.

Rendering steel and iron wares incorrodible. James Alfred Briggs, Wellington Street, Middlesex, and George Mutlow Abell, Gloucester. July 3, 1874.—No. 2319. The application to the steel and iron wares of the scientific process or processes for rendering in iron the state technically known as the passive state, with the object of rendering them incorrodible.

Improvements in the manufacture of blue colouring matter. Edouard George Peter Thomas, Star Chemical Works, Brentford, Middlesex. (A communication from Charles Adam Girard, Rue des Ecoles, Paris.) July 4, 1874.—No. 2347. This Provisional Specification describes heating one or more of the tertiary monamines, methyl-diphenylamin, ethyl-diphenylamin, and amyl-diphenylamin with oxalic acid. The Specification also describes purifying the blue colouring matter so produced.

Improvements in the process of and apparatus for reducing ores of manganese and other metallic oxides. Jonathan Ireland, jun., Edward Street, Broughton Lane, Manchester, Lancaster. July 8, 1874.—No. 2395. This invention relates to the reduction of ores of manganese and other metallic oxides to a condition of spongy metal by feeding a mixture of ore with carbonaceous matter into an annular passage at the top of a reducing vessel, and allowing it to descend by gravity along the vessel, subject for a certain distance to the heat of an annular flue, in which there is a combustion of gas and air admitted by side apertures, and for a further distance to the cooling action of an iron casing water jacketted, the metallic sponge being removed from time to time in portions through a door at the bottom of the casing.

Improved means or method of treating and clarifying impure or waste water from fulling mills, scouring mills, or scouring processes, dychouses, sewage, or other impure waters. Samuel Hallsworth, Armley, near Leeds, and Richard Bailes, Woodhouse Carr, Leeds, York. July 9, 1874.—No. 2408. The employment of bisulphate of iron, or sulphuric acid and iron, or sulphuric acid and mother-liquor from the crystallisation of copperas, for effecting the sediment of the impurities after agitation.

An improved method of and apparatus for disinfecting and deodorising the injurious gases arising from sewers and drains. Frederick Dixon, surgeon, Cliftonville, Brighton, Sussex. July 9, 1874.—No. 2409. The object of this invention is to effectually disinfect and deodorise the gases given off at the ventilating shafts, or other openings of sewers and drains, by causing such gases to pass through flannel, cloth, sponge, or other porous material saturated with a disinfectant or deodoriser, the flannel or other material being fitted in a suitable apparatus.

Improvements in treating sewage water and other foul liquids for the purpose of purification, and in the manufacture of manure. Edward Augustus Schmersahl, manufacturing chemist, Manchester, Lancaster. July 11, 1874.—No. 2439. The features of novelty in this invention consist in treating sewage water and other foul liquids with a mixture of about 2 parts diluted sulphuric acid and 1 part of hydrochloric acid, or with phospho-muriate of lime, commonly called bone liquor, or with chloride of manganese, and then adding sufficient milk-lime to the sewage to neutralise the acid. Besides purifying the liquid, a precipitate is thus formed, which may be used alone as manure, or be added to other manurial agents in the manufacture of manure.

An improved process for treating sewage and for utilising certain products derived therefrom, which improvements are partly applicable to other purposes. William Alexander Lyttle, engineer, The Grove, Hammersmith, Middlesex. July 13, 1874.—No. 2446. The features of novelty are as follows:—First. The utilisation of the sedimentary matter or "sludge" of sewage in the smelting of iron, the carbonaceous matter and the silicates of the sludge being made to serve in various ways as auxiliary to the fuel and fluxing materials now employed. Second. The consolidation of the "duff," or colliery dust of coal, or the dust of peat charcoal, by incorporating sludge with such dust, and then making the mixture into lumps for smelting fuel. Third. The consolidation in the last-mentioned way of a mixture of crushed iron ore, lime, sand, powdered fuel, and sludge, so as to make a conglomerate containing in itself all the materials of a smelting-furnace charge. Fourth. The filtration of the effluent water of sewage through a "vortex filter," consisting of charcoal kept in slow movement by a pug-mill arrangement. Fifth. The recovery of ammoniacal liquor from the exhausted charcoal of this filter by coking. Sixth. The use of the charcoal in the first instance for filtering the drinking-water supplied to a town before such charcoal is used for sewage purposes.

Improvements in the recovery of carbonate of ammonia from sewage. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. July 13, 1874.—No. 2450. The patentee commences operations, as a ready means of arriving at the compound required, by employing calcined magnesite or magnesia produced in any other way, to which has been added such a quantity only of phosphoric acid or soluble phosphate, or phosphate dissolved in mineral acids, as will leave the magnesia in considerable excess.

A new or improved antiseptic fertiliser. William Edward Newton, civil engineer, Chancery Lane, Middlesex. (A communication from Robert Augustus Cheseborough, New York, U.S.A.) July 13, 1874.—No. 2451. The invention consists of a new antiseptic fertiliser, composed in part or in whole of a combination of bone-black and hydrocarbon oil.

Improvements in the treatment of urine and liquid sewage in order to fix the azote and phosphate substances contained therein, and convert them into solid matter, and in apparatus for the same. William Spence, patent agent, Quality Court, Chancery Lane, Middlesex. (A communication from Émile Seraphin Joseph Forgeois and Victor Louis Claye, both of Paris.) July 14, 1874.—No. 2461. The liquid sewage and fœcal matter are passed without filtration into a series of receptacles placed at successively lower levels, in which receptacles the material, after being mixed with acid and well stirred, is gradually dried. The product is a material containing in a fixed but soluble state all the azote and phosphorus contained in the original matter, but retaining the richest ingredients for manure.

Improvements in the manufacture of artificial stone for buildings, floors, and other purposes. James O'Friel, Brooklyn, New York, U.S.A. July 16, 1874.—No. 2500. This invention has for its object a cement which will resist great cold. I first make a cement composed of lime 55 parts, alumina 8 parts, silica 24 parts, potash of soda 3 parts, water glass in solution 10 parts. The above is allowed to set, and when required for use I make a composition as follows:—3 parts of clean sharp silix or sand mixed with 3 parts of cement when dry, and then wet them with an aqueous solution of liquid glass.

MEETINGS FOR THE WEEK.

TUESDAY 18th.—Civil Engineers, 8.
—— Zoological, 8.30.
—— Royal Institution, 3. Prof. Gladstone, "On Chemical Force."
WEDNESDAY, 19th.—Society of Arts, 8.
—— Pharmaceutical, 11. (Anniversary).
—— Meteorological, 7.
THURSDAY, 20th.—Chemical, 8. "Notes on Milk, in Health and Disease," by A. H. Smee, jun.; "On the Effects of Pressure and Cold upon the Gaseous Products of the Distillation of Carbonaceous Shales," by J. J. Coleman; "On some Nova Scotian Triassic Trap Minerals," by Prof. How; "On some Points in the Examination of Waters by the Ammonia Method," by W. H. Deering; "On the Agricultural Chemistry of the Tea Plantations of India," by Dr. Campbell Brown; "On the Structure and Composition of Certain Pseudomorphous Crystals, having the Form of Orthoclase," by J. A. Philips; "On Nitrosyl Bromide, and on Sulphur Bromide," by M. M. Pattison Muir.
—— Royal Institution, 3. Prof. Dewar, "On the Progress of Physico-Chemical Inquiry."
—— London Institution, 7.
FRIDAY, 21st.—Royal Institution, 8, Weekly Evening Meeting. Mr. J. Baillie Hamilton, "On the Application of Wind to Stringed Instruments," 9.
SATURDAY, 22nd.—Royal Institution, 3 Mr. W. H. Pollock, "On the Drama."
—— Physical, 3. Mr. H. Bauermann, "On the Electric Conductivity of Anthracite Coal." Mr. W. Spottiswoode, F.R.S., "On a Revolving Polariscope." Mr. E. J. Mills, F.A.S., "On Fusion-Points and Thermometry."

SCIENTIFIC CLUB.

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THE CHEMICAL NEWS.

Vol. XXXI. No. 808.

THE RIVERS' POLLUTION BILL.

The London correspondent of an eminent German scientific journal a short time ago characterised the ruling powers of England—quite irrespective of party supremacy—as "a government very unfavourable to science and to her followers."* This censure is decidedly justified by the sanitary measures of the present administration. The "Adulteration of Food and Drugs Bill" insults science by subjecting the results of chemists of high professional standing and European celebrity to revision by a body of men of whose very existence the intellectual world is scarcely aware. The Bill now under our consideration, if it does not treat chemistry with formal contumely, ignores her very existence. We were always of opinion that the pollution of rivers was essentially a chemical question. The proposed law shows that Her Majesty's advisers are of a different conviction.

The Bill prohibits the introduction into streams and rivers of "filthy, poisonous, noxious, or polluting" liquids. But who is to decide on the application of these terms? One person—interested possibly in the preservation of fisheries, or in the beauty of a stream flowing through his estate—may extend them to any outfall less pure than distilled water. Another—solicitous chiefly for the easy management of a dye or chemical works—may think such epithets too harsh for the liquid refuse of his establishment. Here, therefore, is already the scope for a "very pretty quarrel."

We are of course duly thankful that the "recommendations" of the late Rivers' Pollution Commissioners are ignored by the Bill, as they have been by the majority of judicious and impartial critics. We have denounced these recommendations, not so much on account of their stringency as of their inconsistency, and of their radically false point of view; and we are, therefore, in the language of Sterne, well content to "wipe them up and say no more about them." But the present Bill takes account neither of the composition—qualitative or quantitative—of matters entering a stream, nor of the proportion they bear to its waters, nor of the state of the river itself: points which ought to be decided by chemical and physical examination it leaves to the vague impressions of the general public. We further read in the Bill that all persons are to use "the best practicable and available means to detain or render harmless" the filthy liquids falling into any stream. But who is to decide what means are, in any particular case, the "best practicable and available"? On this head we know that doctors—not to speak of charlatans—differ.

Returning to the Bill, we find that a municipal corporation or local board may continue to run sewage into any river, if the best available means for its purification have been adopted. The same may be done, under the same conditions, by a manufacturer or mine-owner, if he has been at work for twelve years or upwards. But if he has been polluting a river for less than twelve years, such manufacturer or mine-owner, whatever means he uses for purifying his liquid refuse, enjoys immunity for two years only. What he is to do hereafter does not appear. We must confess that we see little reason for so arbitrary a distinction.

Again, it has been generally suggested—and in some respects it has been positively enacted—that certain kinds of manufacturing refuse should be kept entirely out of town sewers, and dealt with separately. Our readers will easily call to mind substances which if once mixed with sewage must prove a formidable, if not insurmountable, obstacle to its utilisation in agriculture, whether by way of irrigation or precipitation. Under this Bill even the residual liquors from india-rubber works and petroleum refuse are to be admitted.

"Saving clauses"—an irreverent friend of ours applies to them an adjective of diametrically opposite meaning—are generally appended to an Act of Parliament lest it should prove too efficacious. The custom has been duly observed in this case. A proviso of that kind exempts the metropolis from the operation of the Act. Consequently, not merely will the sixty sewers which still pour their filthy waters into Father Thames within the metropolitan district be permitted to flow on unchecked, but the gigantic pollutions of Barking and Crossness—dear to engineers in one sense, and to ratepayers in another—are not to be "affected." Why the Metropolitan Board of Works should be thus exceptionally privileged, in contrast to the corporations of Liverpool, Dublin, Glasgow, Manchester, Leeds, &c., is difficult to imagine. Perhaps the very magnitude of the offence makes filth—like murder and robbery—respectable.

We can scarcely pronounce this Bill a specimen of the vigorous sanitary legislation which we expected from the present administration. It shows, indeed, good intentions, but they, as we know, oft-times pave a way upon which it is not profitable to travel.

* "Eine der Wissenschaft und ihren Jüngern sehr abhold gesinnten Regierung."

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from page 204).

Up to this time, the following methods of preparation were either in use, or had been proposed:—The original process of Priestley, heating oxide of mercury, of course, the most expensive, and the least suited for technological purposes; then Scheele's method, treatment of peroxide of manganese with sulphuric acid, the result being manganous sulphate and oxygen. On the large scale, since the investigations of Berthier in 1822, this was replaced by the simple ignition of manganese, and finally the action of heat upon the chlorate of potash. The last-mentioned process, in spite of its costliness, has become established for laboratory operations, as being convenient and requiring only a small supply of heat, although it has frequently occasioned explosions when the gas was being too rapidly liberated. To prevent such accidents, it has been repeatedly proposed to mix manganese with the chlorate of potash. Recent accidents, especially a fearful explosion in a pharmaceutical laboratory in Paris, induced Debray and Bourgoin† to make known the precautions used in Deville's laboratory. Manganese, or the red manganoso-manganic oxide (Mn_3O_4), which is more easily obtained in a state of purity, is mixed with the chlorate of potash in equal weights, and the iron retort is heated in a furnace filled with fuel in such a manner that the fire may be kindled at the top. Schwartz‡ made known accidents occasioned by the use of manganese adulterated with lamp-black, or by the accidental use of the sulphide of antimony instead of manganese, and he therefore very justly recommends that oxygen gas mixture should be previously tested by heating a portion upon platinum foil. Munck‖ proposed to use oxide of iron instead of manganese, as being more easily distinguished.

Scheele's process—the mutual action of manganese and sulphuric acid—has the disadvantage that the glass is often broken by the congelation of the manganous sulphate. To prevent this, Wagner§ proposes to use, instead

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† Debray and Bourgoin, *Ber. Chem. Ges. zu Berlin*, 1870, 240.

‡ Schwartz, *Breslauer Gewerbeblatt*, 1865, 7.

‖ Munck, *Pohl's Lehrbuch der Technologie Wein*, 1865, 186.

§ Wagner, *Jahresberichte*, 1866, 198.

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of sulphuric acid, bisulphate of soda. An easily fusible double salt is thus formed which does not break the glass as it cools. Pure peroxide of manganese, when thus treated, evolves 18 per cent of oxygen, but only 12 per cent if ignited, when it is converted into sesquioxide. Nevertheless, the latter process is the more economical. Deville and Debray* calculate the expense according to the source of the manganese, as follows:—

Ten kilos. of Manganese from	Cost.	Price of 1 cubic metre of O.
	Francs.	Francs.
Romanèche	10	4·86
Spain	16	3·45
Pyrenees	18	3·86
Giessen	27	4·87
Italy	40	5·98

The trifling value of the residual sesquioxide which contains iron, and is therefore useless in the glass manufacture, is not taken into account. This calculation dates from the time when the re-oxidation of manganese was still an unsolved problem. If the price of oxygen obtained from manganese ranges from 3·45 to 5·98 francs it is cheaper by more than one-half than that procured from chlorate of potash, which Dupré† calculates at 10 francs.

Deville and Debray‡ found a much cheaper source in sulphuric acid, which, at elevated temperatures, is resolved into water, sulphurous acid and water. Retorts containing 5 litres of very infusible glass were partially filled with platinum foil, or with fragments of brick, and heated to redness, whilst sulphuric acid was allowed to flow in in a slender stream. The escaping gases are led through a cooling apparatus in order to condense sulphuric acid, and into water to remove sulphurous acid. By this process 2·436 kilos. of sulphuric acid of the sp. gr. 1·827 yielded 240 litres of oxygen at the expence of 1 franc per cubic metre. On its application the cost of smelting platinum was from 20 to 30 centimes per kilo.

According to a paragraph by Moigno‖ the firm of José de Susine and Co., of Paris, prepared by this process oxygen at 0·85 franc per cubic metre, re-converting the sulphurous acid into sulphuric acid.

Instead of the free acid Deville and Debray propose the use of sulphate of zinc; 100 kilos. of the anhydrous salt yielded in their experiments 6·8 cubic metres of oxygen, —far more than the best black oxide of manganese—22 kilos. sulphurous acid gas, and 51 kilos. oxide of zinc.

(To be continued).

VOLUMETRIC ESTIMATION OF ZINC.

By F. MAXWELL LYTE, F.C.S.

Some advantage will be found by the employment of a uranic salt as an indicator in the estimation of zinc volumetrically, by means of ferrocyanide. The zinc should be in solution, in hydric chloride by preference, and the solution should be pretty strongly acid. Iron or copper should not be present, nor should nickel or cobalt.

When a solution of zinc in hydric chloride is heated to 80° or 100° C., rendered pretty strongly acid, and a drop or two of uranic acetate added, and then a solution of potassium ferrocyanide run in from a burette, a brown spot of uranic ferrocyanide forms where the potassium ferrocyanide falls, but disappears on stirring so long as a trace of zinc remains unprecipitated; but the moment all the zinc has become converted into ferrocyanide, the next drop or so of potassium ferrocyanide tinges the whole liquid brown. I prefer, in practice, not only adding a trace of uranic acetate to the zinc solution, but at the same time—at the end of the operation—trying a drop of the zinc solution on a white porcelain plate, with a glass rod moistened with the uranic salt. The reaction seems to me in this case slightly more delicate, while the operator is warned of the approach of the termination by the fact that the brown colour in the liquid disappears rather more slowly towards the end of the operation.

Example.

Estimation of Zinc in a Sample of Plumbiferous Blende.—Two grammes of the finely-pulverised ore were boiled in a porcelain capsule, covered with an inverted glass funnel, with strong hydric chloride. The solution was decanted into another capsule, and the residue boiled again with fresh hydric chloride, a few crystals of potassic chlorate being added towards the end of the operation. The first liquid was now returned to the capsule from which it had been poured, and mixed with the second solution and the siliceous residue, and the whole was evaporated to a small bulk with a further addition—if requisite—of a few more crystals of potassic chlorate, to ensure the complete peroxidation of all the iron. The contents of the capsule were now washed out into a beaker glass, and a cream of barium carbonate in water poured into the liquid, in quantity sufficient to precipitate all the iron. After standing in the cold for about four or five hours, the liquid was separated by filtration, and, the residue being washed on the filter, the liquid was introduced into a measured flask of 200 c.c. capacity, about 10 c.c. of strong hydric chloride were added, and, lastly, water to make up the bulk of the liquid to 200 c.c.

The potassic ferrocyanide solution is made by dissolving 43·2 grms. of the purified, re-crystallised, dry salt in water, and making up the bulk to 1 litre. Such a solution corresponds, bulk for bulk, with one containing 10 grms. of pure zinc dissolved in hydric chloride, and the solution made up to 1 litre capacity. Consequently 1 c.c. of the said ferrocyanide solution corresponds to 0·01 grm. of zinc.

Twenty c.c. of the zinc solution derived from the 2 grms. of blende were now taken, and placed in a small beaker glass, with about their bulk of water and 3 drops of a solution of uranic acetate, and the beaker was heated in a small steam-bath to nearly boiling, and the ferrocyanide solution run in. As soon as 70 c.c. had been added, the brown stain produced in the solution was seen to disappear more slowly after each addition. A few drops of uranic acetate were now placed separately on a white plate, and the ferrocyanide being only added a drop or two at a time to the zinc solution, it was observed that the admixture of a drop from the beaker with one of the drops on the plate produced the barest possible commencement of discolouration when 73 c.c. of ferrocyanide had been added. Deducting 0·2 c.c. for the quantity of ferrocyanide which was necessary to produce the colouration (for an excess was of course necessary), we have 72·8 c.c. as the quantity employed for the precipitation of the zinc contained in 20 c.c. of the liquid—*i.e.*, in 0·2 grm. of the blende; but each 1 c.c. of the ferrocyanide is equivalent to 0·01 grm. of zinc,—therefore we have $36{\cdot}4 \times 0{\cdot}01 \times 100 =$ the percentage of zinc contained in the sample.

The sample in question contained about 2·7 per cent of copper, but the copper was precipitated with the iron by the barium carbonate. Had it been in greater excess it might have been necessary to precipitate it as subsulphocyanide before titration by the ferrocyanide.

The advantages of my method are—

1. That the zinc may be estimated directly in the solution of the chloride, as it almost always occurs in analyses.
2. That the end of the operation can be more exactly and readily perceived with the uranic indicator than with any other reagent I know of.

Laboratoire, 6, Cité de Retiro, Faubg. St. Honoré, Paris, May 10, 1875.

* Deville and Debray, *Comptes Rendus*, li., 822.
† Dupré, *Compt. Rend.*, lv., 736.
‡ Deville and Debray, *Compt. Rend.*, li., 822.
‖ *Les Mondes*, 1867, p. 494.

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NOTE ON SILVER ALUM.

By A. H. CHURCH.

ELEVEN years ago I described in the CHEMICAL NEWS, (vol. ix., 1864, p. 155) the preparation of silver alum by heating in a sealed tube equivalents of silver sulphate and aluminium sulphate with a quantity of water insufficient to dissolve the former salt at 100° C. Had Mr. Sergius Kern looked into the *Jahresbericht der Chemie* for 1864, p. 286, he would have found his description in this week's CHEMICAL NEWS of the composition, preparation, and properties of silver alum anticipated by the ninth part of a century!

May 15, 1875.

NOTES UPON SUGAR ANALYSIS.

By G. C. STEWART, F.C.S.,
Greenock.

(Concluded from page 213.)

Estimation of the Non-Crystallisable Sugar.—This is best done volumetrically, after Fehling. He prepares a standard solution of "copper-liquor," by dissolving 34·639 grms. of chemically pure cupric sulphate in 200 c.c. of water, and 173 grms. of Rochelle salts in 480 c.c. of solution of caustic soda (1·14 sp. gr.), and dilutes the two solutions, when mixed, to 1 litre, by volume, with water. Ten c.c. of this solution contain 0·34639 grm. cupric sulphate, and correspond exactly to 0·05 grm. *anhydrous grape sugar.* The solution, thus prepared, is standardised against a standard solution of grape sugar, containing 0·5 grm. in 100 c.c. of water.

Expt. 1.—Fehling's solution was prepared by dissolving 12·1378 grms. of cupric sulphate in 100 c.c. of water, 60·61 grms. of Rochelle salts in 168·19 c.c. of solution of caustic soda (1·14 sp. gr.), and the mixed solutions were diluted with water to 350·4 c.c.

(*b*). The standard solution of grape sugar was prepared by dissolving 0·7404 grm. in 100 c.c. of water.

Upon titration, 10 c.c. of "copper-liquor demanded 6·5 c.c. of the sugar solution to reduce all the oxide to the state of suboxide. But this *volume* of sugar solution contains 0·0481 grm. of grape sugar.

	Theory.	Practice.
10 c.c. of "copper-liquor" =	0·050	0·048

Expt. 2.—Fehling's solution was prepared by dissolving 10·1146 grms. of cupric sulphate in 100 c.c. of water, 50·516 grms. of Rochelle salts in 140·16 c.c. of solution of caustic soda (1·14 sp. gr.), and the mixed solutions were diluted with water to 292 c.c.

(*b*). The standard solution of grape sugar was prepared by dissolving 0·8846 grm. in 250 c.c. of water.

Upon titration, 10 c.c. of "copper-liquor" demanded 12·62 c.c. of the sugar solution to reduce all the oxide to the state of suboxide.

But this *volume* of sugar solution contains 0·0446 grm. of grape sugar.

	Theory.	Practice.
10 c.c. of "copper-liquor" =	0·050	0·044

Expt. 3.—Fehling's solution was prepared by dissolving 11·2638 grms. of cupric sulphate in 100 c.c. of water, 56·255 grms. of Rochelle salts in 156·08 c.c. of solution of caustic soda of 1·14 sp. gr., and the mixed solutions were diluted with water to 325·17 c.c.

(*b*). The standard solution of grape sugar was prepared by dissolving 0·5953 grm. in 250 c.c. of water.

Upon titration, 10 c.c. of "copper-liquor" demanded 20·85 c.c. of the sugar solution to reduce all the oxide to the state of suboxide.

But this volume of sugar solution contains 0·0496 grm. of grape sugar.

	Theory.	Practice.
10 c.c. of "copper-liquor" =	0·050	0·049

Having prepared many of the above solutions, I have found it best to carefully ascertain their strength previous to titration.

The actual Analysis.—I measure 10 c.c. of the "copper-liquor" into a small glass flask of about ¼ litre capacity, and dilute this with 40 c.c. of water; I then heat the mixture to incipient ebullition, and from a burette I run in the sugar solution in 1 c.c. at a time. After the first cubic centimetre has been added, the fluid shows a greenish brown tint, owing to the hydrated and suboxide of copper suspended in the fluid. Whenever the precipitated suboxide shows its characteristic red colour, I add the sugar solution cautiously until *one* drop completes the reaction.

Like all other processes in volumetric analysis, the final point of the reaction is the most difficult to observe; indeed, the success of most volumetric processes depends mainly upon the precision in which the end of the reaction becomes evident. In titrating *raw* sugar solutions, it is not advisable to remove the extractive matter previous to reduction; no constant results are got by the procedure. The influence of this organic matter in these highly dilute sugar solutions, if any at all, must be very slight indeed.

Estimation of the Extractive Organic Matter.—All samples of *raw* sugar except beet sugar contain a considerable quantity of this substance. It is best estimated gravimetrically by dissolving about 4 grms. of the raw sugar in a very small quantity of boiling water, and precipitating by addition of solution of tri-plumbic acetate. Whenever this is accomplished, raise the mixture to the boiling-point, pass the supernatant clear sugar solution through a weighed filter, then throw the residue upon the filter, wash most carefully for a long period of time with absolutely boiling water, dry in the water-bath for two hours, and weigh. The increase in weight of the filter-paper expresses the sum of the extractive *residue*, which may be easily raised to per cent. The sum of the extractive organic matter may afterwards be determined by special calculation, including deductions, the details of which need no explanation.

There can be no doubt that the success of this experiment depends chiefly upon the rapidity of the filtration. When the sugar solution, which need not be more than 40 c.c., is passed through the filter-paper at boiling-point, all goes well; but, if it is allowed to cool, filtration becomes tedious, and no amount of boiling water will ever free the residue from lead and syrup. I always precipitate in a very small glass beaker, as I have found by experience that it is much easier to get the residue upon the filter than were a glass flask used. The results in the hands of an experienced manipulator are very satisfactory.

Estimation of the Insoluble Organic Matter and Sand and Clay.—All samples of *raw* sugar contain a small proportion of insoluble matter, which is best estimated gravimetrically by dissolving a weighed quantity of the sugar in a large volume of boiling water, and allowing the insoluble matter to settle. The supernatant sugar solution is afterwards decanted; the residue is then washed three times with boiling water by decantation, thrown upon a filter, again carefully washed, dried for two hours in the water-bath, and treated as follows:—The dried residue is carefully transferred, by means of a feather, to a weighed platinum crucible, and weighed; the increase in weight expresses the sum of the *total insoluble matter.* The filter-paper is then carefully incinerated until the ash is white, and the contents of the crucible are ignited for some time, and again weighed. Upon deducting the filter-ash, the residue may supply the sum of the *sand and clay*, the *insoluble organic matter* being found by difference.

Estimation of the Moisture, Ash, and Total Organic Matter.—Sugar, when ignited, leaves a pure white ash, which may consist of sand, soluble peroxide of iron, and salts of the alkalies and alkaline earths, chiefly those of calcium, potassium, and sodium. I always weigh out

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about 2 grms. of the sugar into a platinum vessel, dry it first in the water-bath for two hours, and report the loss as *moisture*. I then char this dried residue at a low red heat, and, as soon as the evolution of empyreumatic matter ceases, I cover the platinum vessel with a muffle, supported over it by means of a clamp, the heating being continued until the residue is white. The increased current of air plying over the heated mass facilitates the combustion of the carbon. This method is liable, however, to increase the amount of sulphates present in the ash, owing to the action of the sulphuric acid derived from the coal-gas; in cases where great accuracy is required, the Bunsen lamp must be replaced by a spirit lamp.

Frequently the carbon refuses to be oxidised. When this happens, it is advisable to place the platinum vessel over the flame of a powerful blowpipe until combustion is complete. The residue is then weighed; after deducting the sand and clay, a calculation will supply the sum of the *soluble salts*. The difference between the two weighings expresses the amount of *total organic matter*.

Iron in Sugar.—The detection of this constituent is a point in the analysis of sugars which is of considerable importance to sugar refiners. I dissolve *the ash* from the previous experiment in a little water, and run the solution thus formed into a moderate-sized test-tube. I then acidulate with a few drops of hydric chloride, and add solution of the potassic sulphocyanide (KCNS), and observe the result carefully; *a blood-red colour* is produced, due to the formation of a soluble iron sulphocyanide $(FeCNS)_3$. This test for iron is the most delicate of all; it will indicate the presence of a ferric salt when all the other tests fail. The red colouration may in such cases be detected more distinctly by resting the test-tube upon a circle of white filter-paper, and looking through it from the top. The sensitiveness of the reaction may be increased by adding hydric chloride, and then ether, and shaking. The ferric sulphocyanide dissolves in the ether, and the colour is concentrated.

This delicate system of detecting iron in sugar answers admirably during the preparation of the quantitative analysis; but at a sugar works, where a great number of samples have to be examined every day, a much rougher test is used, viz., tincture of galls. Some of the sugar we wish to examine is placed in a glass phial, such as is used by sugar refiners to contain "sugar-liquor;" it is dissolved in a small quantity of water, and the tincture then added and the moisture vigorously shaken. If a ferric salt be present, *a black solution* will form of the ferric vanogallate (black writing ink), and the deeper in proportion.

Valuation of Raw Sugar.—In refining *raw* sugar, several points demand special attention. The crystallisable sugar is important as determining the amount of refined capable of being produced, the fruit sugar and soluble salts as retarding crystallisation to a large extent, and the extractive organic matter the amount of animal charcoal required to extract it from the raw sugar, as well as the amount of deterioration which the charcoal itself suffers.

The French method of assaying raw sugars is, upon the whole, very satisfactory. It is based upon two assumptions—(1) That each percentage of fruit sugar prevents the crystallisation of *an equal* amount of crystallisable sugar; (2) that each per cent of soluble salts prevents the crystallisation of five times its own weight of crystallisable sugar.

To value a sugar, then, we must multiply the sum of the soluble salts by five, add the quotient to the sum of the fruit sugar, and deduct the whole from the crystallisable sugar; the remainder is the crystallisable sugar *obtainable* (*vide* analytical table).

I propose shortly to considerably extend these notes upon the analysis of sugar in my future communication, and afterwards bring forward the subject of sugar crystallisation (boiling) in vacuum sugar pans.

Cappielow Sugar Refinery, Cartsdyke,
by Greenock.

SOCIETY OF PUBLIC ANALYSTS.

Pressure of space compelled us to abbreviate to the smallest dimensions the discussion which followed the reading of the report which the Council of the Society presented to the general meeting on the 5th inst. As, however, several points of interest were raised, we now think it worth while to subjoin a somewhat fuller report of the proceedings.

Dr. Dupré—There are two points in the Bill which I should like to draw attention to; and if the Council have not already urged the subject upon the Government, I would ask them to do so. First of all, there is the clause where it is stated that any purchaser should be allowed, or should be compelled, to divide the sample into three portions. That seems to be an exceedingly objectionable clause; it, in fact, puts the analyst entirely at the mercy of anybody who likes to tamper with the sample. And perhaps I may just state that, happening to be only last week in a town which I will not mention, the inspector sent a boy to take a sample. The man himself went with him. The sample was taken, divided into two parts, and each one had a seal put on, to make the two samples so that they could not be tampered with. As it happened, the analysis of the Analyst was disputed, and both samples were put into my hands, so that I can speak with perfect certainty that the two samples were not the same. In spite of the seals having been put on, and in spite of both sides swearing that the samples were identically the same, they were extremely different; so that there can be no doubt whatever that one or other sample had been tampered with. Of course, if that division is carried out, such cases would occur very often. It would be very difficult for the Analyst to prove that his analysis was correct, more particularly if the certificate is to be admitted where the poor Analyst is required to retain the entire remainder of the sample. Well, then, I should like it to be urged most strongly on the Government, that the only satisfactory division of the sample is in the presence of all the three parties—the purchaser, the seller, and the Analyst. The next point is, that, at present, any sample that is to be analysed by the Public Analyst is bought by the two inspectors; the inspector puts his mark, and the Analyst does not at all know where it comes from. The Analyst returns his certificate, simply stating, "I have received a sample marked so-and-so, and it is" either "pure" or "adulterated." Such a certificate is very difficult to make use of for the purpose of advertising. Under the present Bill every purchaser may come to the Analyst himself. He brings the sample, and the Analyst is to return a certificate stating, "I have received a sample of so-and-so;" and he is to address it, not only to him, but to everybody it may concern, which, of course, would be all the people who buy such things. Under those provisions it is almost impossible for an Analyst to draw a certificate, or to write in such a manner that the certificate cannot be used for the purpose of advertising; and, of course, there is no guarantee that the sample that he has analysed will be the same afterwards sold. Now, I am strongly of opinion that there is nothing that has thrown so much discredit upon Analysts as this indiscriminate giving of certificates; and a good many Analysts, as it is well known, have always strenuously objected to giving any certificates. It seems to me exceedingly hard, after we have struggled for a long time against giving any such certificates, that we are here required by law to give a certificate to every man who is willing to pay the half-crown or ten shillings for the analysis which is made. I should therefore urge strongly upon the Council to bring it before Government, that either the present plan be retained—that is, that every purchaser is to bring the article to the inspector, and that he simply keeps the sample marked with a figure which the inspector puts on without knowing where it comes from—or that no certificate given by a Public Analyst

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should be made use of for the purpose of advertising. Of course that might be the case. I see that several other points have been mentioned, and I hope that the Council will see whether they can manage to bring this before the Government. I am afraid that this is the last public occasion upon which we may have an opportunity of speaking before this Bill passes the House of Commons. I should like to hear some further remarks made, because it will be the most important business we can do this evening to really fairly settle this question. Some of the papers may very fairly wait, but this is a matter which cannot wait.

Mr. WIGNER—I think, perhaps, it would be better, even at the risk of a little informality, to answer questions at once. First, as to the 13th clause. I have personally urged twice upon Mr. Clare Sewell Read the alteration which is proposed in the 13th clause, and I received a half promise that the Government would make it; and, more than that, he promised to accept the amendment if put on the paper by a Member, and one now stands on the paper by Dr. Cameron, which will provide that the inspector will bring away out of the shop two out of the three portions. The Analyst will have the choice of which of the two he keeps. It is but an imperfect substitute, I admit, but it is the best that we have yet been able to get. As to the words in the certificate—"I retain the residue of the sample not consumed in the analysis herewith"—the Government explained distinctly that they did not mean by that the portion of the article which we have not used, but that they mean by it the portion referred to in the 14th section; that is, that when a sample is sent by post to the Analyst he shall send back the reference sample, and that is the portion that is referred to. The phraseology will, we hope, be altered in committee. As to the question of certificates, the Government have in their possession the new form of certificate which we have adopted; and, in addition to that, an amendment is on the paper in Dr. Cameron's name which virtually amounts to the same thing.

Mr. BLYTHE—I wish to urge upon the Council a few things in reference to this particular Bill. I, myself, undoubtedly, am very much obliged for the amendments proposed by the Council, and all the Analysts in the United Kingdom, I am sure, share my feeling of gratitude for the trouble they have taken. But there are two ways of looking at a Bill—the one microscopically, and the other as a whole; and I think that, as far as I have heard or read hitherto, the Council have rather looked at it clause by clause, and not looked upon it as a whole. I was extremely surprised to find that by their silence they have approved the principle upon which this Blll is based, as I have always held, that the sanitary principle is most erroneous. Now if we look at the adulteration laws in existence in Europe at the present time, we find that the law of France is based upon fraud, with certain sanitary provisions. The law of Belgium only deals with the adulteration of food with noxious substances; and in other countries—in Germany, Switzerland, and Italy—the regulations are, I know, entirely sanitary. But why is that? It is because they have no sanitary laws like our own. Now, it so happens, that the sanitary officers of the United Kingdom can deal most effectually with foods at the present time if they are injurious to health; so that, after looking at it from that one single point of view alone, if the legislature wishes to make a Bill for dealing with things with that one single point of view, all that they have to do is to enlarge the 109th and 110th sections of the present Consolidated Public Health Bill, which will be shortly considered in Parliament. Those sections consolidate various Acts relating to food, and give powers to the Medical Officers of Health to inspect, examine, and, if necessary, seize any animal, carcase, meat, poultry, game, flesh, fruit, vegetables, corn, bread, flour, or milk exposed for sale; so that if the legislature wished to make a Bill merely for the protection of the public health, all that they would have to do would be to enlarge that section, so that the Medical Officer of Health can have those articles analysed, and Public Analysts appointed in each county. That is why I think the principle is entirely erroneous. But if it be a sanitary act, then it should be consolidated with the Consolidated Sanitary Act, and carried out entirely by sanitary commissioners, and not by a mixture of chemists and public officers. Then I would also urge upon the Council the amendment of that clause appointing no less than five inspectors to take samples. If it be a sanitary Bill, then let the sanitary officials carry out its provisions. If it be a Bill based upon fraud, a proper man to collect samples is a police-constable, or, at all events, the police force. I cannot understand this mixture of sanitary officers and policemen. The Act by which we hold our appointments appointed three officers, and that, I believe, is too many. There should be but one person appointed by the legal authority. There is another point to which I think due prominence has not been given, and I would urge upon the Council to try and get an amendment in that respect, and that is, that it should be equally carried out all over the country, and that it should be compulsory. It is a very curious thing that it is about the only Act which does harm if not fully carried out. For example, if you are extremely active in one particular county, and the neighbouring county is not active, the adulterated goods are drafted from one county to the other. I have taken the counties, and made a table of them, which shows that the percentage of adulteration in the counties alone varies from 7 per cent to 48 per cent. Now if we are all working equally upon proper principles, it shows to my mind very clearly that there are some districts more sophisticated than others; that is, that the wholesale adulterator, if he has not a map in his office with the active districts marked with a particular colour, and the active towns marked with a particular colour, has it in his brain; and where the analyst is not there it is he drafts his goods. In twenty-seven counties no appointment appears to have taken place. Therefore, I think I am right in asking the Council to put this very strongly before the Government.

Mr. WANKLYN—I should wish to make a few remarks on the question of the object of this Act. Touching the desire to make this an Act to put a stop to fraud, there are great practical difficulties in the way of any enactment dealing with fraud; but really this Act appears to me to be partly a sanitary Act, and partly an Act for dealing in a much more stringent manner than with the mere question of fraud. We do actually propose to punish people, not when they are not sufficiently vigilant, but we propose to punish dealers for ignorance, for carelessness, and for fraud; and we do not propose to pass any judgment as to which of these dealers have offended. It appears to me that, in this respect, the Act is very wide indeed. The Act would be almost unworkable with our laws if we were to require the proof of fraud against people; but, if we are not required to prove fraud, and if all that we have to do is to show that the articles of food do not come up to the value, and so punish a man either for fraud, or for want of knowledge, or for negligence, I think the Act better for the community than if we were to deal simply with fraud. I regard the Act as a very broad one.

Dr. STEVENSON—With regard, Sir, to the division of samples, I may state that, ever since I have been an Analyst, in two of my districts the process of division of samples has been carried out under legal advice, in a manner which is almost—I may say certainly—identical with that which Mr. Wigner has explained to be proposed as an amendment on the new Bill, and it is this:—That, when the sample is procured by the inspector, he divides it into three portions, one of which he seals up and leaves with the vendor, and the other two portions are brought to me, both sealed, by the inspector. One of these is divided, and the other is not divided, but is retained; so that if, in case the vendor should produce an analysis rebutting my own, there would be the sample which wa

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taken by the inspector in his presence, and which the vendor has had an opportunity of putting his seal upon at the time it was procured. In this way there would be three samples, so that any tampering with the sample could at once be detected. I may state that this has been carried on with many hundreds of samples, and that no difficulty has arisen except in one case, where the vendor disputed my analysis of butter, and procured a certificate of another analyst, to the effect that the sample which he had sent him was unadulterated. That same analyst subsequently, on analysing my sample, agreed with me, and said that it was adulterated. That was the only case in which any difficulty arose. I cannot make out that in that case there was any tampering with the sample; but it seems rather that the analyst had changed his opinion. With regard to the approval of the Bill, I think the Council would energetically repudiate any such statement as that they approved the Bill as it went before Parliament. The original Bill, as first printed, met with a most energetic opposition on the part of this Council. The effect has been that the original Bill, which has been passed *pro forma*, is virtually a new Bill altogether.

Mr. Jones—There seems to me one difficulty about the division of the sample into four portions, as proposed by Dr. Stevenson, and it would arise in the case of bulky or extensive samples. Taking beer as an instance, where we require half a gallon of beer for an analysis, you see the amount of bulk that the inspector would have to carry about with him. In order to deliver his samples, he would have to take, according to Dr. Stevenson, about three gallons.

Dr. Tripe—I do not propose to go into a discussion with regard to any part of the principle of the Bill. I would merely point out that there is a somewhat singular misconception that five persons may obtain the samples, or that five persons might be appointed by the authorities to obtain them. The words of the 12th section are clear:—"Any Medical Officer of Health, Inspector of Nuisances, *or*" (not *and*) "Inspector of Weights and Measures, *or* inspector of a market, *or* any police constable, at the direction and at the cost of the local authority, appointing such officer, inspector, or constable, may procure any sample of food or drugs." Now, in the face of those disjunctives, I cannot think how anybody could take them as the copulatives, and say "*and*" in every case where the Bill has distinctly stated "*or*." I may say that the Council held a long meeting, and that they gave a vast amount of time—I know, for myself, that it has been time that I could very badly spare—in discussing this Bill, and we are satisfied that we have had it materially altered, and have obtained an alteration for the better; but we do not approve of it as it stands, although we think that it is better to get the best you can than to oppose it tooth and nail, and say, "We will have nothing to do with it if you do not alter it as we wish." My opinion is, in these matters, that the law of England has been to a great extent a matter of compromise between party and party, and those who are so extremely ultra, as a rule, get nothing. If you can make a good compromise, I think it is far better than to go farther and fare worse.

Mr. Wigner—The Council have proposed very strongly that the Government should make the appointment of Analysts compulsory, and the last reply was—"When you can pass a law which can compel a sufficient number of capable analysts to be found in every town, then we will make the Act compulsory, but not until then." They evidently have an opinion that it is utterly impossible to find competent analysts everywhere. As to the division of the samples, I may say that I have pressed it as strongly as possible; therefore, all that can be done as to the sealing of the samples has been done.

Dr. Redwood—I would just like to offer one remark in reply to what has been said by Dr. Dupré—merely an explanation. Dr. Dupré seemed to think that the 11th clause, as it stands, would be objectionable, inasmuch as it sanctions, or authorises, any purchaser of an article to take such article to an Analyst and get it analysed for a small fee, which shall not exceed half-a-guinea; and the objection I take to be founded very much upon this: that the certificate so obtained may be used for the purposes of advertisement. I presume that many Analysts have occasionally to do what I am sometimes called upon to do, namely, to analyse privately, and not officially, articles which may also, under other circumstances, go before the official Analyst through the inspector. That is to say, grocers will sometimes send samples of tea, or other articles, to be analysed. I have always made it a practice to refuse to issue certificates in such cases on any other condition than that the certificate shall refer to the article merely under a certain letter and number; and I never introduce into the certificate the name of the person from whom the article is received; and I do not see anything in the Bill, as it stands, that requires the Analyst to do anything more than to indicate who the party is from whom he has received the article. Without the name, I do not see how the certificate could be used for the purpose of advertisement in the manner indicated.

Dr. Dupré—I think you will see, if you read the certificate, that it is headed—"To Mr. So-and-so, and all whom it may concern." The Analyst is obliged to state that he has received from Mr. So-and-so a sample of such and such an article. I say the law, coupled with the certificate, is very objectionable. Either one by itself might not be objectionable.

Mr. Sutton—My name has been mentioned in connection with the suggestion with regard to those who are connected with pharmacy—for instance, having anything to do as Public Analysts. Well, I can quite see a great deal of force in that. I can quite see the objection that is taken, on theoretical grounds, to anybody who is concerned in any business—in a pharmaceutical or dispensing business, and so on—having anything to do with a matter of this kind. But, at the same time, I can quite excuse myself personally, as I can excuse other people too, from being involved necessarily in any complication in the matter, just in the same way in which I am concerned. I happen to be the chemist of the Norfolk Chamber of Agriculture, and I happen, also, to be a manufacturer of manures on a very large scale, and I do not know at all what samples come to me. They come to me quite independently of my own knowledge, and I cannot tell my samples from any other person's samples; and I might condemn myself readily, as I might condemn other people, without knowing who was who. If you know that you have a man whom you can depend upon, it does not much matter. We cannot find analysts in every corner of the country, or just everywhere; and we must find men who have got special experience. And I must say, with regard to pharmaceutical chemists, that their botanical education and other studies, which are well calculated to instruct them in many things connected with this investigation, very much fits them for the post of Analyst. But I cannot get rid of the feeling in my mind that I should not like to have the appointments put into the hands of those people exclusively, or even largely. At the same time, if you can depend upon the people having the skill for it, there need not be any objection. Of course, they can be checked in every way. If there is any trickery, it will soon be found out, and it seems to me that, so long as you get hold of the right man, it does not matter what he may be. The rule that would exclude everybody in the business is a mistake, but still it has its claims; and, having said that, I leave it.

A METHOD OF DETERMINING THE FUSING-POINTS OF FATS.

By ARTHUR ANGELL.

Principle.

If a weight be placed upon the top of the cold fat, the fusing-point of which is to be estimated, it will sink as

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soon as the fat is so far liquefied as to present less resistance than the weight can overcome.

If this sinking be found constant, and a given weight be universally used, reference tables of relative sinking or fusing-points may be constructed for all fats; and if mixtures of fats be found to behave in accordance with the figures set down in these tables, then the qualitative and percentage composition of a given mixture may be approximately estimated.

The most convenient form of weight is that of a glass bulb containing mercury, the gravity of which is of course not arbitrary: all our figures are, however, based upon one weight, and of course—if our tables are to be of any use—that same weight must be adopted.

The bulb is made by blowing a small globe on the end of a piece of glass tubing of ¼ inch outside diameter, and drawing it off with a tapering neck, very near the bulb. By this means a pear-shaped float is obtained. Sufficient mercury should be introduced to cause the bulb to weigh 3·4 grms., which is the weight of the bulb used in our experiments.

The bulb should displace, as near as possible, 1 c.c. of water, when immersed in a burette. Absolute accuracy is not necessary, since it was found that a slight difference —say from 5 to 10 milligrammes—in weight, or a little variation in shape, does not materially affect the results.

Butter and mixtures of it with other fats are the fatty substances with which food analysts will have mostly to deal: our researches have, therefore, been pushed in that particular direction, and only those fats have been tested which are likely to be used as adulterants of butter.

By using such a weight as that described above the sinking-point of all butters comes within the limits of 3 degrees, and any number of observers witnessing an experiment would agree when to read the thermometer. Beef, mutton, pork, and other fats, are also equally constant, provided that they are taken from the same part of the animal.

To take the sinking-point of a butter, place 20 or 30 grms. in a dish or beaker, and melt in the water-bath: when quite fluid pour into a test-tube, of ¾ inch interior diameter and about 6 inches long, until filled to within about 2 inches of the top. Keep the tube warm until the whole of the water, casein, and salt has sunk, and left a *perfectly clear fat*; now solidify, by immersing the tube in water of 15° C. temperature. Immerse the tube containing the sample in cold water, contained in a beaker of the capacity of 1 litre: the top of the fat must be about 1½ inches below the surface of the water. A convenient method of fixing the tube in position is to pass it through a hole drilled in a piece of wood, and placed across the top of the beaker: by this means two or more sinking-points may be taken at the same time. Having fixed the tube in an upright position, drop the bulb on to the surface of the fat. The arrangement is now complete, and heat may be applied by means of a Bunsen burner, raised so as to just touch the sand-bath. The water should now be stirred at intervals, and the thermometer read off just as the whole of the globular part of the bulb has sunk beneath the fat.

The following results had been obtained by this method previous to the month of August last year, and many other samples of pure butter have since been tested, with a like result: the numbers are placed without selection, in the order in which they were obtained:—

Sinking-Point with Genuine Butters.

Butter from town-fed cows	35·3° C.
,, Hertfordshire	36·1
,, St. Lawrence	34·8
,, Chale	36·3
,, Newport	35·3
,, Ventnor	35·3
,, ,, No. 2	35·5
Farm butter from Niton	34·8
Fresh ,, Ventnor	35·1
Farm butter from Chale	35·6° C.
,, ,, ,,	36·3
Rancid butter	35·8
Farm butter from Chale	36·3
,, ,, Ventnor	35·5
,, ,, ,,	34·3
Sussex butter	35·5
Normandy butter	35·7
Butter from Ventnor	36·1
,, ,,	35·3
Jersey butter	35·3
Butter from Guildford	35·7
,, ,,	35·3
Salt butter from Ventnor	35·9
,, ,, ,,	34·8
Average of twenty-four samples (Varying from 34·3° to 36·3°.)	35·5

*Adulterated Butters.**

I. Butter from Ventnor, 1s. 2d. per lb.	35·9°
II. ,, London, ,, ,,	42·7
III. Kiel butter, 1s. per lb.	38·4

No. 1 was found to contain 32·83 parts of genuine butter and 67·17 of foreign fat, the sinking-point of the mixture being normal: the fat used as adulterant had, therefore, a sinking-point very near that of genuine butter, and was probably dripping or some prepared fat.

Sinking-Point of Fatty Acids from Butter.

I.	41·8°
II.	42·1
III.	40·5
IV.	41·1

Sinking-Point of Fats other than Butter.

Tallow from candle	53·3° C.
Butterin (patented)	31·3
Ox fat	from 48·3 to 53·0†
Mutton fat	from 50·1 to 51·6‡
Lard	from 42·1 to 45·3
Dripping	42·7
,, from beef	43·8
,, ,,	44·5
,, veal	47·7
,, mixed	42·6
Cocoa butter	34·9
Palm oil	39·2
Stearin	62·8

Sinking-Point of Mixtures.

		Found.	Calculated.
66·7 per cent butter and	33·3 tallow	43·1°	42·0°
73·0 ,, ,,	27·0 mutton fat	42·3	40·2
10·0 ,, ,,	90·0 ,,	48·8	49·6
85·0 ,, ,,	15·0 ox fat	38·1	38·1
69·8 ,, ,,	30·2 ,,	39·5	39·8

ON A METHOD OF TAKING THE MELTING-POINT OF FATS.

By CHARLES HEISCH.

THERE is nothing either original or novel in the method of taking the melting-points of fats which I have to describe to-day; but as it has yielded in my hands better results than any other which I have tried, and as experience has taught me the precautions necessary to ensure concordant results, I have thought it worth while to bring the method, and more particularly the said precautions, under your notice.

The method is a very slight modification of one described some thirty-five years ago by a gentleman who was at that time a pupil in the Laboratory of University College,

* Proved to be adulterated by subsequent treatment.
† Average, 50·6°.
‡ 50·9°.

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in a paper in which he pointed out the fact that some fatty bodies had two melting-points. Glass tubes, of about 0·2 inch bore, are drawn out at the end till almost capillary, the capillary portion being about 3 inches long. The melted fat is drawn into this to the height of about 1 inch, and allowed to cool; in the original plan the end of the tube was sealed, but since that time it has become customary to leave it open. The tube is then placed, together with a thermometer, in a beaker of water, the part of the tube containing the fat being on a level with the bulb of the thermometer, which should be at least 2 inches from the bottom of the beaker. Heat should be now applied very gradually, the temperature being raised at the rate of about 1° F. per minute, and the moment watched at which the fat rises in the tube. The experiment is made by placing one beaker within another, the tube and thermometer being in the inside beaker, there being 2 inches of water at the bottom of the inner beaker and 1 inch at least round it. I always take the melting-point in two different tubes, and when two beakers are employed the difference will never be more than about ½ a degree. When only one beaker is employed accidental circumstances will sometimes cause a warm current of water to rise against the tube, and make a greater discrepancy in the results; but the difference between two experiments is never great, as may be seen from the following results obtained from butter-fats freed entirely from curd and water. I may mention that No. 1 is the fat of absolutely pure butter, to which no salt had been added. The others are believed to be pure butters. The difference in the melting-point of No. 1 and the others is very marked. The experiment with No. 1 was repeated five times, the largest differences being those indicated in the table.

Melting-Points.

	Tube No. 1.		Tube No. 2.	
	Degs. C.	Degs. F.	Degs. C.	Degs. F
No. 1 ..	36·3 =	97·5	35·6 =	96
No. 2 ..	31·3	88·5	31·1	88
No. 3 ..	31·1	88·0	31·7	89
No. 4 ..	30·9	87·5	30·6	87
No. 5 ..	32·2	90·0	32·2	90
No. 6 ..	33·0	91·5	32·8	91
No. 7 ..	32·2	90·0	33·3	92
Lard ..	38·8	102·0	39·5	103
Suet ..	44·3	112·0	43·8	111

I should mention that all shaking of the beaker should be avoided. A person walking heavily across the room will make several degrees difference in the apparent fusipg-point.

In order to try how far the water in the inner vessel was heated regularly throughout, experiments were made with thermometers at the surface and at different depths in the inner vessel, and when the temperature did not rise at a greater rate than 1° F. per minute the variation among them was (after the water had reached about 75°) not more than 0·25° F..

"SALE OF FOOD AND DRUGS BILL."

The Committee on this Bill was resumed on the 13th inst., and—though there were still five pages of amendments on the paper—such rapid progress was made that before the House rose the Bill passed through Committee, and was reported. It is needless to say that the majority of the amendments were either withdrawn or negatived, and many of them were so impracticable that their authors could never have seriously contemplated their being accepted by the House.

Clause 22 provides for appeals to Quarter Sessions, and gives power to such Courts to "finally determine the matter of such appeals."

In the previous clause, referring to the examination of samples by the *employés* in Somerset House, Sir H. W. Peek endeavoured very hard to get the word "final" inserted, and in this clause he made an equally strenuous attempt to get the word "finally" struck out. We are glad, for the credit of the House of Commons, that he was equally unsuccessful in both efforts.

Clause 24, which provides a method of escape for a retailer innocently selling adulterated goods, where he can produce a written warranty of purity from the wholesale dealer, was hotly contested, and it was amusing to see the change of front on the part of members representing "trade" interests. Hitherto their contention has been that adulteration is all a myth; but when asked to display the courage of their opinions by guaranteeing their customers from loss by means of a warranty, they protested vehemently against having to do anything of the kind. The fairness of the provision being, however, obvious to all unprejudiced persons, and the President of the Local Government Board insisting that unless the words were retained the whole Bill would fall to the ground, the clause was agreed to.

Various other amendments were considered, some minor ones were accepted, and ultimately, as we have said, the Bill passed through Committee.

We hope to present our readers with a copy of the Bill, as it now stands, very shortly, and we will reserve any further remarks until we are able to do so.

CORRESPONDENCE.

MELTING-POINTS OF FATS.

To the Editor of the Chemical News.

The author of "An Easy Method of Taking the Melting-Point of Fats" (Chemical News, vol. xxxi., p. 205, 1875) does not seem to know that his process has long been in use, and is published in at least one manual, "Chemistry; General, Medical and Pharmaceutical" (Van Voorst), at page 313 of the first edition of that work (1867), and in each of the subsequent editions the following sentences occur:—

"Heat a fragment of the substance till it liquefies, and then draw up a small portion into a thin glass tube about the size of a knitting needle. Immerse the tube in cold water contained in a beaker and slowly heat the vessel till the thin opaque cylinder of solid fat melts and becomes transparent; a delicate thermometer placed in the water indicates the point of change to the fifth of a degree."

The author of the paper proposes to record a softening point rather than the true melting-point of the fat. Why?

T. A.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 15, April 19, 1875.

The President (M. Fremy), in his opening address, paid a tribute to the memory of the unfortunate aëronauts, MM. Crocé-Spinelli and Sivel.

Second Note on the Theory of the Processes of Magnetisation.—J. M. Gaugain.—Not adapted for abstraction.

New Source of Magnetism.—M. Donato Tommasi.—If a current of steam at a pressure of 5 to 6 atmospheres is passed through a copper tube of 2 to 3 m.m. in diameter, and coiled spirally around an iron cylinder, the latter is magnetised so effectually that an iron needle, placed at the distance of some centimetres from the steam magnet,

is strongly attracted, and remains magnetic as long as the steam is allowed to pass through the copper tube.

Unequal Solubility of Different Surfaces of the same Crystal.—M. Lecoq de Boisbaudran.—The author has previously (*Comptes Rendus*, October 12, 1874, p. 1868) shown the mutual independence of the surfaces of a crystal in presence of a solvent; the simple forms behaving in some respects like so many polymorphic modifications of one and the same body. From this principle it results that the curves of solubility of different orders of surfaces are not necessarily parallel, whence result possible changes in the sign of the relative solubilities of two surfaces when the physical conditions vary. The following experiment is suited to demonstrate the independence of crystalline surfaces:—An octahedron of alumino-ammoniacal alum, 25 m.m. in diameter, and having small cubical facets, was placed in a basic solution of the same salt, the liquid being kept for a long time in a state of very slight supersaturation. The diameters of the crystals, *i.e.*, the distances between the centres of the cubic facets, had been carefully measured. After some time, the weight had increased by about one-eighth, and the cubic facets had acquired a relatively considerable extent. In spite of this assimilation of matter, the distances between the centres of the cubic surfaces had not varied. The deposition of matter, therefore, had been exclusively effected on the octahedral surfaces; on the cubic surfaces it had been *nil*. Thus the solution was supersaturated as regards the octahedral surfaces, but not as regards those which were cubic. The unequal solubility of different surfaces of the same crystal explains the following fact:—When, after having mutilated a crystal, it is replaced in a mother-liquor which gives up to it scarcely anything, we know that the fracture separates, and that the crystal quickly resumes its original form. This phenomenon is readily understood if we consider that the new surfaces laid bare by the fracture are always more stable (assimilate dissolved matter more readily) than the surfaces of the intact crystal. The fact may be expressed thus:—Every crystal takes the form for which the quantity of matter which undergoes the change of state is a minimum. If, therefore, the liquid is only just saturated as regards the intact surfaces of the crystal, it will be inevitably supersaturated in relation to the surfaces of the fracture which, being alone able to assimilate the dissolved matter, become obliterated. The crystal may thus repair itself without anything being deposited upon its intact surfaces.

Note on the Bronzes of Japan.—E. J. Maumené.—The composition of the specimens in question is as follows:—

	I.	II.	III.	IV.
Copper	86·38	80·91	88·70	92·07
Tin	1·94	7·55	2·58	1·04
Antimony ..	1·61	0·44	0·10	—
Lead	5·68	5·33	3·54	—
Zinc	3·36	3·08	3·71	2·65
Iron	0·67	1·43	1·07	3·64
Manganese ..	—	trace	—	—
Silica	0·10	0·16	0·09	0·04
Sulphur	—	0·31	—	—
Loss	0·26	0·79	0·21	0·56
	100·00	100·00	100·00	100·00

The author considers these bronzes as the result of the direct use of copper pyrites and antimonial galena, mixed with blende.

Part Exercised by Alkaline Salts on the Vegetation of the Beet-root and the Potato.—M. Pagnoul.—Salts of potash improve the yield, the mean of which is 273 quintals in two cases where it was used, and only 230 in the cases where soda was applied. Alkaline nitrates and sulphates are more favourable than chlorides and sulphate of ammonia. The ash of the roots in all the experimental lots contained not a trace of soda. The absorption of chlorides does not benefit the plant, these salts exerting no useful function in vegetable life.

Equivalence of Alkalies in Beet-root.—MM. P. Champion and H. Pellet.—The alkaline carbonates in the ash of beet-root are not only saturable by a constant quantity of sulphuric acid, but the totality of soda and potash contained in the ash in the state of phosphate, sulphate, chloride, and carbonate corresponds to the same weight of acid. It is the same with the ash of the leaves if the mode of cultivation is the same, whilst the proportions of soda and potash in the manures are varied. The authors hope to show in a future memoir that the law of the substitution of bases in accordance with their equivalents is not a fact peculiar to beet-root, but extends to wheat, barley, maize, scarlet beans, peas, mustard, flax, &c.

Note on the Dextrogyrous Acid of Wine.—E. J. Maumené.—The author believes that the acid isolated by Béchamp in a great number of wines is the trigenic.

Part of Microzymas in the Acid, Alcoholic, and Acetic Fermentation of Eggs.—M. A. Béchamp.—A reply to the paper by M. Gayon, *Comptes Rendus*, lxxx., p. 674.

Moniteur Scientifique, du Dr. Quesneville, March, 1875.

Retrospective Studies on Liebig.—A triology comprising an account of Liebig's scientific career, by H. Kolbe; a review of his agricultural researches, by Prof. Stehmann; and an account of his investigations in animal chemistry, by M. Neubauer. We hope to return, by opportunity, to this paper. At present we merely extract the startling fact that during the first ten years of his professorship at Giessen Liebig received merely the contemptible salary of £70 per annum, out of which he had to pay his assistant, and to provide apparatus and reagents—the laboratory furnished him by the University consisting merely of four bare walls.

Properties of Salicylic Acid.—H. Kolbe.—In this paper, and in the subsequent one by Neubauer, attention is called to the remarkable antiseptic and antizymotic power of salicylic acid. This property it is proposed to utilise in medicine, in the preservation of food, and in the manufacture of fermented liquids—cases where the carbolic and cresylic acids are not applicable on account of their offensive taste and poisonous properties.

On Aniline Inks.—C. H. Viedt.—For a red ink the author recommends a solution of 1 part of "diamond fushin" (we should say of Brooke, Simpson, and Spiller's rosein) in 150 to 200 parts of boiling water. For a blue he dissolves 1 part of bleu de Paris in 200 to 250 of water. For a violet, 1 part of a Hofmann's violet (blue shade) in 300 of water. A beautiful green ink is made by dissolving 1 part of iodine green in 100 to 110 parts of boiling water. The yellow aniline inks are not recommended. These inks are not fit for copying, but they have the advantages of drying quickly, and of never clogging.

Means of Distinguishing the Coal-Tar Colours.—The coal-tar reds most generally met with in commerce are magenta, saffranin, and red corallin. The aqueous solution of magenta is coloured by acids a yellow; that of saffranin a violet-blue; and that of corallin gives a yellow precipitate. Three principal violets are met with, the phenylic, the iodine, and the methylic. Dissolve a part in alcohol, and add ammonia. If the solution becomes red, the colour is a phenyl-violet; if it is completely discharged, we have an iodine- or a methylic-violet. To decide between these two, dissolve a little of the colour in water, and add ammonia. The iodine-violet is decolourised, and gives a clear solution, whilst methylic violets become colourless, but troubled. The two coal-tar blues known at present in the market are aniline blue and Nicholson blue. The latter may be known by its forming a colourless solution in water, which turns blue on the addition of an acid. The most common greens are aldehyd green and iodine green, with or without picric acid. If the colour dissolves in water it is iodine

if not, it is dissolved in alcohol, and a solution of potassium cyanide added. Aldehyd green is decolourised under the influence of this reagent, whilst the picrate of iodine green is turned brown. The most usual yellows are picric acid, with its salts, and naphthalin yellow, all being soluble in water. Mix the aqueous solution with a solution of potassium cyanide, and heat. If the liquid becomes a reddish brown, picric acid or one of its salts is present. If the colour is merely somewhat deepened, we have naphthalin yellow. To distinguish between free picric acid and its salts, a portion of the sample is moistened with benzol, and heated. If the body dissolves it is picric acid, if not, a picrate. Among the oranges the chief are—Yellow corallin, the salts of chrysaniline and chryso-toluydin, and Victoria orange, as well as a mixture of naphthalin yellow and of magenta, known as "aniline orange." Dissolve a little of the sample in alcohol, and add some zinc and dilute sulphuric acid. If the liquid is decolourised it is corallin; if it preserves its colour it is a compound of chrysanilin. If ammonia does not produce a red colouration, dissolve a part of the sample in water, and add an acid. If there is no change, it is a compound of chryso-toluydin; if a precipitate appears it is Victoria orange, or a mixture of both. To decide, take a small portion of the aqueous solution, and add solution of cyanide of potassium. If the liquor turns brown on heating we have Victoria orange; if the shade is but slightly modified, it is a mixture of naphthalin yellow and magenta. The chief browns are—Aniline brown, maroon, garnet, and two phenyl browns; that prepared with carbolic acid, and that with phenylen-diamin. Examine if the substance is soluble in water; if not, add hydrochloric acid. If the solution turns yellow it is maroon; if there is no change add a little ammonia. If a precipitate appears, it is either aniline brown or phenyl brown prepared with phenylen-diamin. If the ammonia produces no effect the colour is garnet (isopurpurate of potash). Phenyl brown is distinguished from aniline brown by adding cyanide of potassium, which precipitates the latter, while it has no effect on the former.

Industrial Preparation of Iodide of Potassium with the Waters used for Lixiviating Kelp or Crude Soda.—The process consists in transforming into iodates the alkaline iodides contained in the lixivium; in precipitating the iodic acid with a soluble salt of baryta; heating the precipitate with a solution of sulphate of potash, by means of which we obtain a solution of iodate of potash; evaporating to dryness, melting the residue, and crystallising the solution of iodide of potassium thus obtained. The transformation of the alkaline iodides of the mother-liquors into iodates may be effected by one of the methods indicated below; but it is necessary to precipitate previously, in totality, or in great part, the sulphuric acid present by means of a solution of chloride of barium. After having removed this precipitate, the mother-liquor is evaporated to dryness, and the residue melted to destroy all organic matter. The melt is then dissolved in water, and the solution filtered. If the treatment is to be conducted on the first, second, or third method, the solution is made alkaline by the addition of a caustic or carbonated alkali; adding so much that there may be, for each equivalent of iodide, 5 equivalents of caustic, or 10 of carbonated alkali. The four methods of subsequent treatment are—(1) Pass through the liquid until all the iodide is converted into iodate, but no longer. (2) Add to the liquid a solution of an alkaline permanganate till a faint but permanent pink colouration results. Separate from the liquid the precipitate of manganese, which may be revivified in known manners. (3) Pass through the dilute liquid an electric current. (4) Add an equivalent of an alkaline chromate for each equivalent of iodide; evaporate to dryness, and heat cautiously, without raising the residue to redness. After the iodic acid has been separated from the lye, the bromide which remains in solution may be converted into bromate by the first or the ourth method.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved treatment of cod-liver oil. William Robert Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. (A communication from Jean G. Hava, New Orleans, Louisiana, U.S.A.) July 14, 1874.—No. 2458. The said invention consists in a solution of tribasic phosphate of lime in cod-liver oil by passing a current of carbonic acid gas in a mixture of gelatinous tribasic phosphate of lime and cod-liver oil under different degrees of pressure.

Improvements in the method of and apparatus for treating residua of distillation, fermentation, and similar operations, in order to obtain and utilise ammonia, carbonic acid, ammoniacal salts, alkaline carbonates, saltpetre, and other products. Michael Henry, patent agent, Fleet Street, London. (A communication from Louis Charles Emeric Faucheux, Boulevart Saint Martin, Paris.) July 16, 1874.—No. 2483. The object of the invention is the treatment of residuary products of distillation and other like processes in order to utilise them, such as the carbonic acid from fermentation of saccharine matters, and ammonia from distillers' wash, for producing ammoniacal salts, alkaline carbonates and bicarbonates, and saltpetre. Various processes are described in which chemical reactions are used. Ammonia may be extracted by means of caustic potassa and soda, obtained by a preliminary operation, and the alkalies are afterwards employed. Lime is used, and afterwards precipitated by the carbonic acid of fermentation, and this mode of obtaining ammonia is by means of gases arising from the combustion of distillers' wash by injecting steam, or by showers of water with or without sulphuric acid. Residua may be treated with caustic alkalies. Ammonia is used in producing bicarbonates. Carbonic acid freed during fermentation is collected in closed vessels with tubes connected with a worm for condensing the alkaline vapours, and with a gas-holder with suction arrangements. The carbonic acid is used for producing bicarbonate of soda by means of ammonia, or with crystals of carbonate of soda, or for producing carbonates, by its action on sulphurets of potassium or sodium, or for producing carbonatation, or for obtaining bicarbonate of potassa, or for other purposes. Apparatus is described for obtaining ammonia, in which a truncated cone is placed in the chimney through which pass the gases to be decomposed, and with which a refrigerator is combined. Apparatus for producing bicarbonate of soda is described, in which cylinders and tanks are combined with arrangements for bringing the ammoniacal and carbonic gases to the solutions, and with refrigerators, such as a chamber and worm, or a contrivance for using the pressure of the carbonic acid. Steam, superheated or not, is used to heat the apparatus in which the bicarbonate is decomposed. A mode is described of extracting ammoniacal salts from residua in a state of hydrochlorate of ammonia without acids. Carbonate of potassa is produced from bicarbonate of potassa and sulphuret of potassium, the bicarbonate being obtained by the action of the carbonic acid from the fermentation. Also, bicarbonate of soda is employed. The disengaged sulphuretted hydrogen is utilised, and sulphites and sulphur are produced. Saltpetre is obtained by treating nitrate of soda, carbonic acid, and ammonia, proceeding from residua, or by a process based on the double decomposition of the nitrate of soda and chloride of potassium under ebullition; and the sea-salt or bay-salt obtained as a residuary product is treated by ammonia and carbonic acid. A mode is described of treating and refining raw potassa for producing saltpetre, or for other purposes.

Improvements in the separation of ammonia from illuminating and other gases. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Benjamin Silliman, New Haven, Connecticut, U.S.A.) July 18, 1874.—No. 2520. This invention relates to an improved process for the purification of illuminating and of other gases, and consists in the employment of certain acid salts for the purpose of removing ammonia and other ammoniacal impurities contained in such illuminating gas or other gases.

Improvements in treating sugar, syrups, and juices for decolourising and purifying same. William Whitthread, analytical chemist, Liverpool. July 20, 1874.—No. 2532. I add to the solutions of sugar, or to the syrups or juices, milk of lime, and heat the mixture. I then add dicalcic phosphate dissolved in an aqueous solution of monocalcic phosphate, or dicalcic phosphate dissolved in water supersaturated with carbon dioxide, or mixed with an absorbed body, such as any kind of charcoal, to defecate the impure syrup or juices; and I remove the insoluble matters by any of the well known means. This part of my invention I prefer to use where weak solutions exist; for stronger solutions, I prefer to filter through charcoal, and cleanse same by any of the well known processes, and I revivify this charcoal by adding to it either of the phosphatic solutions above described.

Improvements in the preparation of superphosphate of lime, and in the manufacture of nitrogenised manures. Rudolf Giebermann, Lower Thames Street, London. July 21, 1874.—No. 2547. The object of this invention is to produce from phosphorites, coprolites, and, in general, from substances which contain, besides phosphate of lime, silicates, fluorides, iron, and alumina compounds, a dry superphosphate of lime, in which the phosphoric acid which has been made soluble in water remains in that state by adding sulphuric acid quickly in form of rain or shower, and keeping the batch agitated or stirred after this time with such rapidity as to prevent, as much as possible, the mass from heating. If desired to prepare nitrogenised superphosphates, there is added together with the sulphuric acid a concentrated solution of horn, hair, hoof, leather, wool, or other animal refuse. By this, manure is obtained containing the nitrogen in a condition readily assimilable by vegetation.

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THE CHEMICAL NEWS.

Vol. XXXI. No. 809.

A SIMPLE METHOD FOR TESTING FOR POTASH.

By J. STEINER,
Chemist (formerly Assistant at the Agricultural High School in Vienna).

The weighed substance, containing not more than 0·2 grm. of K_2O, is to be treated, after dissolving it in a few c.c. of hot water, with a clear concentrated solution of caustic baryta, and heated for about ten minutes. The liquor now contains the alkaline salts and BaH_2O_2. By conducting in CO_2, and heating afterwards to expel the free CO_2, the solution retains the alkaline salts only. A drop of pure Na_2CO_3 added to the clear liquor ascertains if the preceding operations are complete. The clear liquor may be filtered and washed with hot water by means of an aspirator.

If properly managed, the liquor does not exceed 250 c.c. After concentrating it in a platinum dish on the water-bath, a few c.c. of HCl are added, the evaporation continued to dryness, the residue dissolved in a little hot water, and, after adding 1 grm. of $PtCl_4$ in about 10 c.c. of water, again evaporated till dry, but at about 90° C. only. By mixing the cold residue with alcohol of 80 per cent, the insoluble $PtCl_4.K_2Cl_2$ may be collected on a filter after about half an hour, washed with alcohol, and dried. The precipitate is reduced by heating it with a little pure oxalic acid to platinum, which is then weighed.

Goulding's Manure Works, Dublin,
May 10, 1875.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from page 222).

Wagner's statement† must be noted that, in the year 1867 both these methods were not carried out in Deville's laboratory, perhaps because the development of sulphurous acid complicated their execution; in fact, they have both been left in the background in industrial practice. As an attempt in that direction, we must notice the procedure of Archereau,‡ who employed sulphuric acid in its cheapest combination, gypsum. He maintained that, by heating ground gypsum with sand, he could obtain silicate of lime, whilst sulphurous acid was set free, which he (as also Susini) chiefly condensed by a pressure of three atmospheres, and removed the rest by passage through milk of lime. A manufactory on this principle, established at Paris, had but a short career.‖ The very high temperature required is evidently a hindrance. Probably the oldest source of oxygen, saltpetre, had not been used for the preparation of the gas, for two reasons. On the one hand, the product is largely mixed with nitrogen, and on the other, the temperature required for its decomposition augments the cost of preparation. Webster§ overcame the latter difficulty by adding to the nitre oxide of zinc. 20 lbs. of soda-saltpetre and 4 lbs. of crude oxide of zinc yielded in his hands 94·676 cubic feet of a mixture of 59 per cent of oxygen and 41 per cent of nitrogen, the residue being chiefly oxide of zinc and caustic soda. In this mixture, which is useful for many purposes, the oxygen cost 2·32 francs per cubic metre if the solid residue be neglected; but, if the latter be utilised, the expense of the oxygen falls to 0·78 franc.*

In all these methods, one of the leading ideas of modern industry, the regeneration of residues, has been neglected. The following proposals are, in this respect, happier, and have, therefore, been partially more successful. To combine the oxygen of the atmosphere chemically with some substance which shall readily give off the combined gas, and be again able to take up and give off fresh quantities of oxygen, as is done by the mercury in mercuric oxide; this is the problem which has been solved in the last few years. As early as 1829, Dingler, Junior,† observed that both oxide of copper and the peroxides of nickel and cobalt, with an excess of chloride of lime, gave off oxygen, converting the latter substance into chloride of calcium. In 1845, Mitscherlich‡ made known the fact that various other metallic oxides, peroxide of manganese, hydrated peroxide of iron, &c., if added to a solution of chloride of lime, occasioned a plentiful liberation of oxygen. In 1865, these observations were renewed by T. H. Fleitmann,‖ with especial reference to recently prepared sesquioxide, small quantities of which sufficed to decompose completely a concentrated solution of chloride of lime into chloride of calcium and oxygen gas. He recommended, in practice, a solution of chloride of lime concentrated as much as possible, and clarified by filtration or deposition to prevent frothing, and then mixed with 0·1 to 0·5 per cent of its contents of sesquioxide of cobalt, and heated from 70° to 80°. On employing chloride of lime at 35 per cent, he obtained oxygen in a regular stream, to 25 or 30 times the volume of the liquid. Other observers, especially F. Varrentrapp,§ confirmed these results, and recommended the industrial adoption of the process. The sesquioxide of cobalt does not require to be manufactured in advance. Any salt of cobalt in solution serves the same purpose, and the sesquioxide settles to the bottom and can be used again in fresh operations.

(To be continued.)

ON AMMONIO-SILVER CARBONATE.

By SERGIUS KERN, St. Petersburg.

By adding, to a concentrated solution of silver carbonate (Ag_2CO_3) in ammonia, ethyl-alcohol (C_2H_6O), a peculiar grey precipitate is received, containing the elements of ammonia. In order to study the reactions and the nature of this compound, some experiments were made, the results of which are as follows:—

The silver carbonate was prepared by mixing concentrated aqueous solutions of hydric sodium carbonate ($HNaCO_3$) and silver nitrate. The yellowish precipitate of silver carbonate obtained was well washed and dried over sulphuric acid; the dried salt was dissolved in ammonia, 0·930 sp. gr., and from this solution the ammonio-silver carbonate compound was thrown down by means of absolute alcohol; the resulting grey precipitate was washed and dried. The ammonio-silver carbonate thus obtained gave the following reactions:—

(1). The compound in the state of perfect dryness takes a more intense dark colour; some drops of ammonia im-

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."
† Wagner, *Jahresberichte*, 1867, 216.
‡ Archereau, *Dingler's Polyt. Journ.*, clxxviii., 57.
‖ Wagner, *Jahresberichte*, 1867, 215.
§ Pepper, Chemical News, 1862, 218.

* Dupré, *Comptes Rendus*, lv., 736.
† *Dingler's Polyt. Journ.*, xxvi., 231.
‡ Mittscherlich, *Pogg. Ann.*, lviii., 471.
‖ *Ann. Chem. Pharm.*, cxxxiv., 64.
§ *Mittheilungen f. d. Gewerbe Vereins des Herzogthums Braunschweig*, 1865-66, 72.

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mediately turn the substance black, and readily dissolve it.

(2). Gently heated to 80°, it commences to yield ammonia gas, which disappears at 100°. This was proved by placing on the top of the crucible red litmus paper, which turned blue. Some drops of hydrochloric acid gave, with the evolved gas, white fumes, proving the gas to be ammonia.

(3). Two grms. of the substance, heated on a sand-bath in a porcelain crucible at the following temperatures, undergoes the following changes :—

100°	The substance blackens.
160° to 170° ..	Conversion into a uniform black mass.
240°	The substance partly whitens from the decomposition into metallic silver.
305°	Conversion into metallic silver.

(4). A solution of ammonio-silver carbonate in ammonia, dried over calcium chloride, gives needle-shaped crystals of irregular form. The crystals dissolved in ammonia turn black, and the undissolved part falls down in the form of a black powder.

(5). The ammonio-silver carbonate, in the form of a black powder, resulting from the experiment No. 4, was dissolved in hydrochloric acid. There was a strong reaction, evolution of gas, and production of silver chloride (AgCl) and of a small quantity of neutral ammonia carbonate [$(NH_4)_2CO_3$], by the following reaction :—

$$Ag_2CO_3.4NH_3+2HCl=2AgCl+(NH_4)_2CO_3+2NH_3.$$

The presence of the ammoniacal salt was proved by testing the salt by means of a concentrated solution of sodium hydroxide (HNaO); ammonia gas was received from the decomposition of the salt :—

$$(NH_4)_2CO_3+2HNaO=Na_2CO_3+2NH_3+2H_2O.$$

(6). The ammonio-silver carbonate may be considered as a direct compound of silver carbonate and ammonia, having the formula $Ag_2CO_3.4NH_3$. At ordinary temperatures, this substance is a stable compound, which may be preserved for a long time without alteration; but, as it is seen from the experiments, it is readily decomposed by the action of heat and acids, with the evolution of ammonia gas.

LECTURES ON THE MORPHOLOGY OF CRYSTALS

AT THE

CHEMICAL SOCIETY.

By NEVIL STORY MASKELYNE, M.A., F.R.S., &c.

(Concluded from page 202.)

Lecture XIV.

There remain to be considered, among the phenomena of crystallography, certain modes of grouping, or of association of crystals in obedience to particular laws, some of which present points of extraordinary interest to the student of physics. The first to be considered among these was that known as the case of twinned or macled crystals. Thus, two crystals parallel in position may be supposed to be the one fixed, and the other turned round an axis, generally the normal of a face through 180°. Sometimes the two crystals appear thus grown together, either in superficial juxtaposition, or else inter-penetrating one another, and that, sometimes, in such a way that parts or laminæ of the one crystal are interpolated between, and alternated with, laminæ of the other crystal, sometimes with even microscopic minuteness. A result of this twinned character is the frequent occurrence of re-entering angles on the crystal.

Among the more singular varieties which arise out of this twin law are cases in which hemi-symmetrical forms have undergone this introversion. Thus, in the cubic system, hemi-symmetrical forms of the type $\pi\{hkl\}$ may be twinned, yet so as not to produce a holo-systematic form, since evidence of the twinning is recognisable in the physical character of the faces. Another very interesting kind of twinning is one of which we may take the mineral boracite as an illustration, in which we find two correlative hemi-symmetrical forms of the type $\kappa\{hkl\}$ united into a crystal which would carry all the faces parallel to those of a octahedron, but in such a way that, for instance, the tetrahedral faces of the one form, $\kappa\{111\}$, present different physical properties from those which characterise the correlative form $\kappa\{\bar{1}11\}$, among which the property of becoming, the one positively electric, and the other negatively electric, by increase of temperature, and again having these electricities reversed as the temperature is lowered, is conspicuous. Further, the faces of one of the tetrahedra are brilliant, and those of the other dull. In such a case, it is clear that the physical properties going one way along a given direction in a crystal are not the same as the properties going the opposite way along it, and this polar character is also met with in crystals that are hemimorphous; that is to say, in which all the faces of a form on one of the sides of a plane (necessarily a unique plane) of symmetry are obliterated. Then, again, there are cases of a species of composition of hemi-symmetrical forms in which two correlative diplohedral, but hemi-systematic forms, as, for instance, two correlative rhombohedra are twinned in such a manner as to build up a holo-symmetrical form. Of this, quartz is a conspicuous example, the rhombohedra, $\{hkk\}$ and $\{sff\}$, uniting to form the twelve-faced dirhombohedron, wherein, however, the physical dissimilarity of the faces of the two forms betray the composite character of the crystal, in spite of their geometrical equivalence.

Finally, we have to consider the singular case of rotatory polarisation of the light by crystals, and this would seem, so far as the few cases that connect this property with crystalline form serve to guide us, to be connected with a hemi-systematic character in the forms presented by the crystal. Victor von Lang has pointed out that, in all the cases so far known, such as the sodium-chlorate, quartz, lead hyposulphate, and sodium-periodate, the hemi-symmetrical forms belong to what in our phraseology would be a hemi-systematic type, of which only one face is extant for each extant normal. Such a generalisation would, if confirmed, preclude the possibility of rotatory polarisation in the orthorhombic, the clinorhombic, and the anorthic systems.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 20, 1875.

Professor Abel, F.R.S., President, in the Chair.

After the names of the visitors had been announced, and the minutes of the preceding meeting read and confirmed, Messrs W. A. Lyttle and Francis Jones were formally admitted Fellows of the Society. The names read for the first time were those of Messrs. L. Bernstein, G. W. Wigner, J. M. Cameron, G. Archbold, and R. W. E. McIvor. For the third time—Messrs. Pattinson Melmore, Gustav Bischof, Charles Gerard Cresswell, Thomas Wardle, Dugald Clerk, William Grant, George Johnstone, and Henry Child, who were balloted for and duly elected.

The first communication, "*Notes on Milk in Health and Disease*," was read by the author, Mr. A. H. Smee. From a series of carefully-conducted experiments, he

found that, although milk taken from herds of cows exhibits great uniformity in composition, yet the milk from individual cows is liable to considerable variation; moreover, it is possible for good average milk to be watered to a limited extent without detection. He observed, also, from a comparison of the milk from cows fed on ordinary meadow grass and on grass from a sewage farm, that in the latter case the milk went putrid after thirty-six hours, and the butter became rancid rapidly compared with that made from the milk of cows fed on ordinary meadow grass. These effects were more apparent in spring than in the latter part of the summer. On three or four occasions, also, he noticed that, when the milk of cows fed on sewage grass was placed on a dialyser, the casein passed through the membrane, from which it would appear that the casein existed in these milks in a modified form. He then proceeded to notice the outbreaks of typhoid fever which had occurred at various places owing to sewage-water having been used to cleanse the dairy utensils, or to reduce the quality of rich milk to the lowest standard allowed by law, showing how important it was that there should be a supply of pure water to every dairy. Moreover, milk which had been exposed to sewer-gas from an untrapped drain, although on analysis it appeared to be unaltered in composition, yet when distilled at a low temperature (160° F.) it yielded a distillate which had a very offensive smell. It also caused intense headache, which was followed by diarrhœa. He also examined the milk of cows suffering from foot and mouth disease and from milk fever, and thought that the methods employed by Public Analysts were not sufficiently delicate to detect the slight physiological changes which may take place in so complex a fluid as milk.

The President observed that there were so many interesting points connected with the subject that it could not fail to elicit a valuable discussion.

Dr. Gilbert said the subject was one of very great importance. Mr. Smee had shown, not only that there was great variation in the milk of different cows, but of the same cow at different times, and yet the evidence he had brought against the use of sewage grass was derived from obvervations on one or two cows. Now that the demand for milk from the country to supply London was so great, it created quite a milk famine in some parts. If we employ the water system for sewage it must be passed on the land where it produces succulent food fit for cows. If the cows were fed entirely on sewage grass the milk was but little inferior to that from unsewaged grass, and with a proper addition of oil-cake the milk was excellent. The analyses in the Report of the Royal Sewage Commission made by Messrs. Way and Evans on the milk of cows fed for a long period on sewage grass and oil-cake showed that the amounts of casein, butter, sugar, &c., were very nearly the same as that of cows fed in the ordinary way, but, as might be expected, there was a slight deficiency in the butter and sugar. No doubt great mischief would arise when sewage-water was used to adulterate milk, or for cleaning the dairy vessels.

Mr. W. Thorp asked whether the cows had been fed for some time previously on sewage grass, or were immediately transferred to it. This was a point of some importance, for the alteration of the diet from the drier to the more succulent one would cause the cows to get out of condition, which would necessarily affect the milk.

Dr. Thudichum said the lowness of the ash in the milk of those cows which had been fed on grains was a physiological question of some interest. The grains had been exhausted of their salts, and the food not containing the proper quantity, the cows would get out of condition. This might, perhaps, be obviated by adding the necessary salts to the food to make up for those removed from the grains.

Dr. Thorne gave some instances in which children fed on milk from cows suffering from foot and mouth disease had suffered from salivation and sore mouths. When the use of the milk was discontinued, the symptoms disappeared. In these cases, the children were at a farm, the milk came direct from the cow, and was used copiously and without dilution. After being allowed to cool, or to stand for some time, the milk did not appear to produce any injurious affect.

Mr. Smee said there were a few points to which he must allude. Dr. Gilbert had stated that the cows were fed with sewage grass, but, as he parenthetically observed, with something dry added, such as oil-cake. It was this something dry which made all the difference, for when nothing but sewage grass was used the cows pined away and died. He must insist that cows cannot be fed on sewage grass alone. Another point was that the casein had become altered, and good cheese could not be made from the milk. He had invariably found that the butter from his own herds, which was ordinarily very good, became so rank and bad when sewage grass was used for the cows' food, that he would not let it come into the house.

Dr. Gilbert wished to say a few words in reply to Mr. Smee's remarks. All sewage grass was very succulent; every farmer knew that ordinary grass in some years was very succulent, and then it was found advisable to give some dry food along with it. Why, then, not give it with the succulent sewage grass? When the fields were irrigated with sewage, the amount of milk per acre was increased four or five times.

Mr. A. H. Smee, in reply, said that he looked upon sewage grass as the only way of getting rid of the sewage, but he found that the dairymen round about him never used it if they could help it, for it made the butter rank. The grass, he learned, was sent up to London to be sold as green meat.

The President, in thanking the author, said he did not think that the opinions of Dr. Gilbert and Mr. Smee differed so greatly as might at first sight appear.

Mr. W. H. Deering then read a paper "*On some points in the Examination of Waters by the Ammonia Method.*" He found that the intensity of colour produced by the Nessler solution went on increasing, and had not come to a stop in ten minutes, the increase being, perhaps, more readily perceived with the paler than with the darker tints. In order to obviate this difficulty, the author, after adding the Nessler to the distillate, and allowing it to stand ten minutes, prepares a caramel solution of the same tint, and compares this with the trial solution of ammonium chloride, which is also allowed to stand ten minutes. He also finds it is necessary to make a correction for the trace of ammonia remaining even in the purest attainable distilled water, and for the alkaline permanganate solution, which should be boiled for a long time, as commercial stick potash gives much ammonia when distilled with water. An important fact, also, is that peaty waters give much ammonia by distillation with sodium carbonate, and much, also, on the subsequent distillation with permanganate solution, which, unless caution be used, might be regarded as evidence of sewage contamination.

The President drew especial attention to the fact that peaty matters existing in potable matters interferes considerably with the indications given by this test. This was a point of very great importance.

Mr. W. Thorp said he had not experienced the difficulties in the use of the Nessler test mentioned by Mr. Deering. He found that, when he began, he could only obtain results accurate within 5 or 6 per cent, but that after a few months he could trust them to within 2 or 2½ per cent, and he had never found anyone who could judge nearer than that: it was therefore not of much practical use to endeavour to eliminate these very small sources of error. If the nitrogen in peat waters were estimated by the combustion process, it would be found that the carbon was large in proportion to the nitrogen, as compared with sewage contamination.

Mr. Hartley said that, in employing the Nessler test in places where other work was being done, it was very necessary to keep the cylinders closed during the distil-

lation, although there might be no odour of ammonia in the room, otherwise erroneous results would be obtained.

Dr. Russell could confirm Mr. Deering's observations on peaty water, for he had collected some on Dartmoor which contained some ammonia as salts and a considerable amount of albumenoid ammonia.

Mr. Deering, in reply, said he quite agreed with Mr. Thorp, that the Nessler test was comparatively inaccurate, from there being only about fifteen colour factors which the eye could distinguish. He appeared to have somewhat misunderstood the object of the caramel solution, which was not to get a caramel standard, but to serve as a comparatively unalterable point of comparison for the solution to be examined and the Nessler.

The President, in thanking the author, said he agreed with Mr. Thorp that the combustion method in some cases possessed considerable advantages over the Nessler test.

The last paper was "*On some Nova Scotian Triassic Trap Minerals*," by Professor H. Howe. He gives an account of centrallassite, stilbite, sphærostilbite, magnetite, and magnetic hæmatite. The first-mentioned mineral, although closely corresponding, in constituents and apparent quantitative composition, with okenite and gyrolite, is merely related to them, closely indeed, but the merging of one into either of the others as a species is inadmissible.

After thanking the author in the name of the Society, the President adjourned the meeting until Thursday, June 3, for which a large number of papers are announced:—(1) "On the Agricultural Chemistry of the Tea Plantations of India," by Dr. C. Brown; (2) "On the Effects of Pressure and Cold upon the Gaseous Products of the Distillation of Carbonaceous Shales," by Mr. J. J. Coleman; (3) "On the Structure and Composition of Pseudomorphic Crystals having the form of Orthoclase," by Mr. J. A. Phillips; (4) "On Nitrosyl Bromide, and on Sulphur Bromide," by Mr. M. M. P. Muir; (5) "On the Action of Chlorine on Pyrogallol," by Dr. J. Stenhouse and Mr. C. E. Groves; (6) "On some New Derivatives of Alizarin," by Mr. W. H. Perkin; (7) "On some Metallic Derivatives of Coumarin," by Mr. Williamson; and several other communications.

PHYSICAL SOCIETY.

May 22, 1875.

Professor Gladstone, F.R.S., President, in the Chair.

The names of the following candidates for election were read for the first time:—The Lord Lindsay, F.R.S.; Sir W. Thomson, F.R.S.; and Prof. Sylvester, M.A., F.R.S.

Mr. Spottiswoode, F.R.S., exhibited and described a "*Revolving Polariscope*." A luminous beam passes from a small circular hole in a diaphragm through a polariscope, the analyser of which is a double image prism, the size of the hole being so arranged that the two luminous discs shall be clear of each other. If the prism be made to revolve rapidly, one of the discs revolves round the other, and is merged into a ring of light, which is interrupted at opposite sides by a dark shaded band, the position of which depends upon the position of the original plane of polarisation. The discs may be coloured by inserting a selenite plate, and the rapid revolution of the analyser then gives alternating segments of complementary colours; or, if a quartz plate be used, the rotating disc passes successively, twice in a revolution, through all the colours of the spectrum, and when the revolution is rapid merges into a prismatic ring. The effect of the interposition of a ¼-undulation plate, which converts plane into circularly polarised light, was then shown, and Mr. Spottiswoode also interposed a concave plate of quartz, and exhibited the effect of rotation on the characteristic rings of quartz.

Prof. Adams, F.R.S., exhibited a polariscope, adapted for showing the optic axes of a crystal in which they are much inclined to each other, as is the case in topaz. The part of the instrument by which this is effected consists of a frame in which the crystal is supported between two hemispherical lenses, the common centre of which is at the centre of the crystal. The frame is capable of motion round an axis at right angles to that of the instrument. By this means each of the axes can be brought under the cross wires, and the space through which the frame is moved affords a means of determining the angle between the axes of the crystal. The crystal may be immersed in a liquid, the cases in which its optic axes are too far apart to be seen in air.

Dr. Mills made a verbal communication on "*Fusion-Point and Thermometry*." His apparatus for fusion-points consisted essentially of a beaker, in which stood an inverted funnel, the shortened stem of which carried a test-tube, supported by a contraction at its base. The test-tube contains naphtha of high boiling-point, and the thermometer and capillary tube containing the substance occupy its centre; the funnel has four equidistant semicircular cuts at the end of its stem, and six on its lips: the beaker is nearly filled with strong oil of vitriol, and has a wooden cover. On the application of heat below the beaker warm oil of vitriol ascends in the funnel, and, cold oil of vitriol descending, enters at the lips. Thus an automatic stirring is kept up, and the mercury in the thermometer rises so regularly as to appear perfectly continuous in course, even under considerable magnifying power. The manner of preparing and filling the capillary tubes was described. Attention was then drawn to the "zero error" of thermometry. In thermometers which have not been much used, the zero error must always be determined immediately after experiment. It is also generally necessary to correct for the projection of the thermometer beyond its bath. This correction had been experimentally determined by the author, and required from 1500 to 2000 observations of temperature for each of four instruments used. It was ascertained that the well-known expression, $C=0{\cdot}0001545(T-t)N$, given by Regnault and Kopp is not supported by actual trial. If we write the expression thus:—$C=x(T-t)N$, experiment shows that x depends on the length N exposed, and $x=\alpha+\beta N$. For lengths of about 25°, x is about 0·00013, and increases about 0·00001 for every additional 25°. The exact values of α and β require, however, to be ascertained for each instrument.

Mr. Bauerman, F.G.S., described and illustrated a very simple method for ascertaining the electric conductivity of various forms of carbon. The method which was originally devised by Dr. Von Kobell, consists in holding a fragment of the substance to be tested with a strip of zinc bent in a U-form, and immersing it in a solution of copper sulphate. In the case of a bad conductor, a deposit of copper takes place solely on the surface of the zinc; but when a good conductor is employed, a zinc-carbon couple is formed, and a deposit takes place on the surface of the carbon. Numerous specimens were exhibited, which showed that the conducting power is greatest in coal which has been subjected to a great degree of heat, and the lowest temperature at which this change takes place appears, in the case of anthracite, to be between the melting-points of zinc and silver. Such experiments appear to be specially important, as giving a clue to the temperature at which anthracitic metamorphism has been effected by the intrusion of igneous rock.

Prof. Woodward exhibited an apparatus for building up model cones and craters. It consists of a wooden trough about 18 inches long with sloping sides; at the bottom of the trough a bladed screw carries forward the ashes, sawdust, or other material used, to an opening through which air from a powerful bellows is forced upwards. A board, 3 or 4 feet square, with a hole in the centre, is placed over the air-jet, and on this the crater is formed. Several of the peculiarities of natural cones may thus be illustrated, and their structures shown by using sawdust of various colours.

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SOCIETY OF PUBLIC ANALYSTS.

THE RECENT CASE OF ALLEGED ADULTERATION OF BEER AT STOKE.

By A. DUPRÉ, Ph.D., &c.

This case has been noticed by several daily and weekly papers, and made the occasion of more or less disparaging remarks against analysts. All these papers seem, however, to have been entirely ignorant of the real facts of the case, and I am therefore induced to give such of the facts as have come before me. I am the more inclined to do so as I see that the House of Commons has rejected Dr. Cameron's amendment on clause 13, requiring the samples to be marked and sealed by the analyst. The case will show, conclusively, the difficulties and dangers which will have to be incurred when samples are allowed to be divided by persons not familiar with the art of securing them against being tampered with.

On March 19th I received a sample of beer from the Secretary of the Licensed Victualler's Protection, &c., &c., Society, in North Staffordshire, with the request to analyse the same. I was told, at the same time, that the beer had been reported against as adulterated with salt. I therefore estimated the chlorine no less than three times, twice by precipitation and weighing, once by neutralising, evaporating, charring, extracting with water, and estimating the chlorine, volumetrically, in the very carefully neutralised solution. The figure given is the mean of these three fairly concordant results. On March 31st I received a second sample of beer, from the magistrates' clerk at Stoke, for the purpose of analysing the same. No other information was given. I had, however, the strongest reason to believe that this sample was supposed to be from the same cask as the preceding one. I learnt afterwards that evidence to that effect had been given before the magistrates. In this case, also, the chlorine was estimated three times, and the mean taken. Having a larger quantity of beer at my disposal than I had in the first case, I examined this sample for some of the other substances stated to be sometimes used for the purpose of adulteration. Without wishing to give any decided opinion as to the substance actually used, I may state that an extract obtained from this beer, which would have contained any picrotoxin present, had a most markedly poisonous effect on fish; the extract obtained in the same way from pure beer is without effect. The following are the results of my analyses:—

	First Sample.	Second Sample.
Alcohol, per cent by volume ..	7·75	7·42
Dextrine	5·04	4·26
Sugar and other extractives ..	0·41	1·27
Ash	0·34	0·40
Chloride of sodium	40·90	136·00
Acetic acid	0·48	0·32

These two analyses were performed by myself, in exactly the same manner, within a few days of each other, and I need scarcely remark that the differences between the two, entirely irrespective of the enormous difference in the chloride of sodium, are very far beyond the errors of analysis.

Before analysts are sneered at, it would be well to make sure that they had really the same samples to deal with. In this case, fortunately, the two samples came into one hand, and the differences are such that there can be no doubt whatever that the samples submitted to me were not what they had been represented to be, viz., two samples of the same beer taken from the same cask at the same time.

I trust that it is not too late even now for Parliament to reconsider clause 13, with a view of inserting some provision which will render such substitution of one sample for another, if not absolutely impossible, at least extremely difficult, and if nevertheless done, to render the perpetrator liable to heavy punishment.

Westminster Hospital, May 22, 1875.

"THE SALE OF FOOD AND DRUGS BILL."

This Bill having now been read a third time in the House of Commons, we think it well to reprint its leading clauses, *and have italicised the alterations* which have been made since its introduction.

A reference to the Chemical News of February 26th, in which the original Bill was printed, will show the tenour and the value of the alterations and modifications. As, however, Clause 5 is not only the principal acting clause of the Bill, but has undergone more changes—and those of more importance—than any other clause, we submit a copy of it as it appeared in the Bill in February, and also reprint it as it now stands.

Having already printed the Bill *in extenso* we deem it unnecessary to reproduce the whole of the clauses, and we therefore omit many of a formal character, possessing perhaps points of interest for lawyers, but not bearing on the functions of the Analyst.

Clause 1 simply repeals the Adulteration Acts of 1860 and 1872, the 3rd section of the "Sale of Poisons (Ireland) Act," and the 24th section of the "Pharmacy Act."

2. The term "food" shall include every article *used for food or drink by man*, other than drugs *or water*:

The term "drug" shall include medicine for internal or external use:

The term "county" shall include every county, riding, and division, as well as every county of a city or town not being a borough.

The term "justices" shall include any police and stipendiary magistrate invested with the powers of a justice of the peace *in England, and any divisional justices in Ireland.*

3. No person shall mix, colour, stain, or powder, or order or permit any other person to mix, colour, stain, or powder, any article of food with any ingredient or material *so as to render the article injurious to health*, with intent that the same may be sold in that state, and no person shall knowingly sell any such article so mixed, coloured, stained, or powdered, under a penalty in each case *not exceeding* fifty pounds for the first offence; every offence, after a conviction for a first offence, shall be a misdemeanour, for which the person, on conviction, shall be imprisoned for a period not exceeding six months with hard labour.

4. No person shall, except for the purpose of compounding as hereinafter described, mix, colour, stain, or powder, or order or permit any other person to mix, colour, stain, or powder, any drug with any ingredient or material *so as to affect injuriously the quality or potency of such drug*, with intent that the same may be sold in that state, and no person shall knowingly sell any such drug so mixed, coloured, stained, or powdered, under the same penalty *in each case respectively as in the preceding section* for a first and subsequent offence.

Clause 5, as originally drawn:—

No person shall knowingly sell any article of food or any drug which is not of the nature, substance, and quality of the article demanded by the purchaser, under a penalty of *twenty* pounds, except as herein excepted and provided; that is to say, except—

Where any matter is mixed therewith for the purpose of rendering it portable, or of preserving it;

Where a harmless ingredient is mixed with it for the purpose of rendering it

Clause 5, as it now appears:—

No person shall sell to the prejudice of the purchaser any article of food or any drug which is not of the nature, substance, and quality of the article demanded by such purchaser, under a penalty not exceeding twenty pounds, except as herein excepted and provided; that is to say, except—

Where any harmless matter or ingredient is mixed therewith for the purpose of rendering it portable or palatable, or of preserving it

palatable or of improving its appearance;

Where according to the usage of trade it is sold in a mixed state;

Where it is the subject of a patent in force, and is supplied in the state required by the specification of the patent;

Where British, colonial, or foreign spirits are reduced from their ordinary strength by persons licensed and paying duties under the excise;

Where a drug is compounded either in conformity with a prescription of a registered medical practitioner or otherwise, according to the usage of trade;

Where the article is unavoidably mixed with some extraneous matter.

or of improving its appearance, unless such matter is used to conceal the inferior quality of the article;

Where the article named is a proprietary medicine or is the subject of a patent in force, and is supplied in the state required by the specification of the patent;

Where a drug is compounded as hereinafter described;

Where the article is unavoidably mixed with some extraneous matter in the process of collection or preparation.

Provided that no article shall be deemed to be within any of the exceptions above set forth, if the matter or ingredient mixed therewith shall have been added with intent fraudulently to increase the bulk, weight, or measure of the article.

6. No person shall sell any *compound article of food which is not composed of ingredients in accordance with the demand of the purchaser, under* a penalty not exceeding twenty pounds.

No person shall sell any compounded drugs except the same shall be compounded *in accordance with the demand of the purchaser, or with* the prescription in writing *of a registered medical practitioner*, or with the regulations prescribed by the British Pharmacopœia issued by the General Medical Council, or in Great Britain with a basis to be laid down by the Council of Pharmaceutical Society of Great Britain, or the Privy Council, *or in accordance with the provisions of the Pharmacy Act*, 1868, *or in Ireland in accordance with the Act of the Session of the thirty-third and thirty-fourth of Victoria, chapter twenty-six*, under a penalty not exceeding twenty pounds.

7. Provided that no person shall be guilty of *any such* offence *as aforesaid* in respect of the sale of an article *of food or a drug* mixed with any *matter* or ingredient not injurious to health, *and not intended fraudulently to increase its bulk, weight, or measure*, if at the time of delivering such article he shall supply to the person receiving the same a notice, by a label *distinctly and legibly* written or printed on or with the article, *to the effect that the article is mixed.*

8. No person shall, with the intent that the same may be sold in its altered state without notice, abstract from an article of food any part of it so as to affect injuriously its quality, substance, or nature, and no person shall sell any article so altered without making disclosure of the alteration, under a penalty in each case not exceeding *twenty* pounds.

At the end of the 9th clause, which provides for the appointment of Analysts, the Government have added the following sub-section:—"Provided that no person shall hereafter be appointed an Analyst for any place under this Section who shall be engaged, directly or indirectly, in any trade or business connected with the sale of food or drugs in such place.

10. The town council of any borough may agree that the Analyst appointed by any *neighbouring* borough, or for the county in which the borough is situated, shall act for their borough during such time as the said council shall think proper, and shall make due provision for the payment of his remuneration, and if such Analyst shall consent, he shall during such time be the Analyst for such borough for the purposes of this Act.

11. Any purchaser of an article of food or of a drug in any place being a district county city, or borough where there is any Analyst appointed under this or any Act hereby repealed shall be entitled, on payment to such Analyst of a sum not exceeding ten shillings and sixpence, or if there be no such Analyst then acting for such place, to the Analyst *of another place, of such sum as may be agreed upon between such person and the Analyst*, to have such article analysed by such Analyst, and to receive from him a certificate of the result of his analysis.

13. The person purchasing any article with the intention of submitting the same to analysis shall, after the purchase shall have been completed, *forthwith* notify to the seller or his agent selling the article his intention to have the same analysed by the Public Analyst, and shall offer to divide the article into three parts to be then and there separated, and each part to be marked and sealed or fastened up in such manner as its nature will permit, and shall, if required to do so, proceed accordingly, and shall deliver one of the parts to the seller or his agent.

He shall afterwards retain one of the said parts for future comparison, and submit the third part, if he deems it right to have the article analysed, to the Analyst.

14. If the seller or his agent do not accept the offer of the purchaser to divide the article purchased in his presence, the Analyst receiving the article for analysis shall divide the same into two parts, and shall seal or fasten up one of those parts and shall cause it to be delivered, either upon receipt of the sample or when he supplies his certificate to the purchaser, who shall retain the same for production in case proceedings shall afterwards be taken in the matter.

16. If any such officer, inspector, or constable, as above described, shall apply to purchase any article of food or any drug exposed to sale, *or on sale by retail on any premises or in any shop or stores*, and shall tender the price for the quantity which he shall require for the purpose of analysis, not being more than shall be reasonably requisite, and the person exposing the same for sale shall refuse to sell the same to such officer, inspector, or constable, such person shall be liable to a penalty of *ten* pounds.

17. The certificate of the analysis shall be in the form set forth, or to the like effect.

Form of Certificate.

To*

I, the undersigned, Public Analyst for the do hereby certify that I received on the day of 18 , from† a sample of for analysis (which then weighed‡), and have analysed the same, and declare the result of my analysis to be as follows:—

I am of opinion that the same is a sample of genuine

Or,

I am of opinion that the said sample contained the parts as under, or the percentages of foreign ingredients as under:—

Observations.§

As witness my hand this day of

A. B.,

at

* Here insert the name of the person submitting the article for analysis.

† Here insert the name of the person delivering the sample.

‡ *When the article cannot be conveniently weighed, this passage may be erased, or the blank may be left unfilled.*

§ Here the Analyst may insert at his discretion his opinion as to whether the mixture (if any) was for the purpose of rendering the article portable or palatable, or of preserving it, or of improving the appearance, or was unavoidable, and may state whether in excess of what is ordinary, or otherwise, and whether the ingredients or materials mixed are or are not injurious to health. *In the case of a certificate regarding milk, butter, or any article liable to decomposition, the Analyst shall specially report whether any change had taken place in the constitution of the article that would interfere with the analysis.*

18. Every Analyst appointed under any Act hereby repealed or this Act shall report quarterly to the authority appointing him the number of articles analysed by him under this Act during the foregoing quarter, and shall specify the result of each analysis and the sum paid to him in respect thereof, and such report shall be read at the next meeting of the authority appointing such Analyst, *and every such authority shall annually transmit to the Local Government Board, at such time and in such form as the Board shall direct, a certified copy of the number of articles analysed.*

21. The justices before whom any complaint may be made under this Act may, upon the request of either party, in their discretion cause any article of food or drug to be *sent to the Commissioners of Inland Revenue, who shall thereupon direct the chemical officers of their Department at Somerset House to make the analysis, and give a certificate to such justices of the result of the analysis; and the expense of such analysis shall be paid by the complainant or the defendant, as the justices may by order direct.*

24. If the defendant, in any prosecution under this Act, prove to the satisfaction of the justices or court that he sold the article in the same state as when he himself purchased it, and that he purchased it as the same article in nature, substance, and quality as that demanded of him, and with a warranty in writing to that effect, he shall be discharged from the prosecution, *but shall be liable to pay the costs incurred by the prosecutor, unless he shall have given due notice to him that he will admit at the hearing the matters charged against him in the information.*

25. Every penalty imposed and recovered under this Act shall be paid in the case of a prosecution by any officer, inspector, or constable *of the authority who shall have appointed an Analyst or agreed to the acting of an Analyst within their district, to such officer, inspector, or constable, and shall be by him* paid to the authority for whom he acts, and be applied towards the expenses of executing this Act, *any Statute to the contrary notwithstanding; but in the case of any other prosecution the same shall be paid and applied in England according to the law regulating the application of penalties for offences punishable in a summary manner, and in Ireland in the manner directed by the Fines Act, Ireland, 1851, and the Acts amending the same.*

26. Any person who shall forge, or shall utter, knowing it to be forged for the purposes of this Act, any certificate or any writing purporting to contain a warranty, shall be guilty of a misdemeanour, and be punishable on conviction by imprisonment for a term of not exceeding two years with hard labour;

Every person who shall wilfully apply to an article of food or a drug, in any proceedings under this Act, a certificate or warranty given in relation to any other article or drug, shall be guilty of an offence under this Act, and be liable to a penalty of twenty pounds;

Every person who shall give a false warranty in writing to any purchaser in respect of an article of food or a drug sold by him, as principal or agent, shall be guilty of an offence under this Act, and be liable to a penalty of twenty pounds;

And every person who shall wilfully give a label with any article sold by him which shall falsely describe the article sold, shall be guilty of an offence under this Act, and be liable to a penalty of twenty pounds.

34. This Act shall commence on the first day of October one thousand eight hundred and seventy-five.

35. This Act may be cited as "The Sale of Food and Drugs Act, 1875."

A MEETING of the Society will be held on Wednesday next, the 2nd of June, at Cannon Street Hotel, at 4 o'clock P.M., when "The Sale of Food and Drugs Bill," which has now passed the third reading in the House of Commons, will be again considered. And the following papers will be read:—"On the Volumetric Estimation of Chlorides, in the Presence of Alkaline Phosphates," by W. C. Young (London); "Improvements in Butter Analysis," by Arthur Angell, F.R.M.S.; "The Decomposition of Milk," by E. L. Cleaver.

NOTICES OF BOOKS.

The Advantages of the Separate System of Drainage. By E. MONSON, Assoc. Inst. C.E. London: E. and F. N. Spon.

THE object of this pamphlet is to show that sewage, in the strictest sense of the term, should be kept separate from surface-water, springs, &c. It need scarcely be said that the more concentrated sewage can be kept, the more economical becomes its treatment by any process whatever. At the same time it can scarcely be denied that the separate system involves a greater risk of nuisance. At present the drains are, from time to time, flushed by storm-water. As an instance that doctors are not the only parties who differ among themselves, we may mention that a certain eminent engineer, so far from recommending the separate system, suggests that the sewage of London should be diluted to four times its present bulk.

Our author is an enthusiastic admirer of the water-closet system, which in practice has proved to be an ingenious contrivance for introducing sewage-gases into our houses, and which leaves a variety of putrescible and noxious matters to ferment in the dust-bin. He seems to entertain an amusingly exaggerated opinion of the effects produced by his pamphlet—"The Sewage Difficulty Exploded." We certainly have failed to trace any change in public opinion to its appearance. Whether or no sewage has a commercial value, it has an agricultural value, and if we only go on pouring it into the sea we must ultimately run short of fertilising matter. The supply of phosphates and of potash is not unlimited, and in proportion as the nearer sources are exhausted, and as other nations compete with us more and more, prices must rise.

Mr. Monson seems inclined to treat the sewage with lime, and either use the effluent for irrigation or run it into the rivers. This process must, in any case, expel the ammonia, and fail to throw down the alkaline salts. As to the sludge produced—*e.g.*, from the sewage of London—we would venture to say it would prove a difficulty scarcely dreamt of in his philosophy.

Fragmentary Papers on Science and Other Subjects. By the late SIR H. HOLLAND, Bart. London: Longmans, Green, and Co.

WE have here a collection of essays on a great variety of subjects, few of which have any direct connection with chemistry or physics. Of these the most noteworthy are those entitled "Matter and Force in Physical Phenomena;" "On Matter, Force, and Motion in Space;" "Divisibility of Matter;" and "The Electric Element." These essays display a very peculiar character. Did we know nothing of their authorship, we should, from internal evidence, feel compelled to pronounce them the work of one thoroughly versed in the results of modern science and feeling a warm interest in its progress, yet, in his own nature, rather a metaphysician than a physicist. So long as he describes the conclusions of others he is scientific, but the moment he attempts to add anything of his own he diverges insensibly into ontology. He seeks for definitions of force, matter, space, life, electricity. Not content with the research into phenomena he strives to penetrate into noumena, and puts questions which have hitherto proved barren, because

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their solution does not lie within the limits of our capacities. He asks, as did the thinkers of earliest antiquity, "What are these unseen forces—call them δυνάμεις, ἐνέργεια, vis viva, potential energy, plastic force, Kräfte, or whatever the diversities or the importance of language may suggest—which thus give movement and change to the material world? What is the matter itself thus acted upon? Is it something brought into existence by a creative will of higher date, or is it eternal in itself, and that with which the Creator worked in evolving and giving laws to the visible universe?" He points out that philosophers have, from time immemorial, asked these questions. He refers with the accuracy of the deeply-read scholar to their doubts, their guesses, and their suggestions. But towards the actual solution of the problems stated he advances no nearer than did his forerunners in this line of thought. We may read his essay on the "Divisibility of Matter." We may recognise in it a fair and full exposition of the present state of human knowledge—and of human ignorance—on the subject. But there is nothing to increase the sum-total of the former, or diminish the sum-total of the latter. He describes eloquently the researches of the past. He does not point the way to the researches of the future. It would, at least, be difficult to find in these essays any suggestion capable of being worked out by the recognised methods of science.

Into the essays dealing with organic science—which seem of higher value—we can, of course, not enter.

Wildungen: Its Baths and Mineral Springs. By Dr. A. Stoecker. Translated by O. Harrer, M.D. London: Trübner, and Co.

An account of the mineral waters of Wildungen, in the territory of Waldeck, which, it appears, are much recommended in affections of the urinary organs. Incidentally the author mentions the curious fact that in Bristol, Leeds, and Norwich, calculus in the bladder is about ten times more plentiful than at other places,—a fact not easy to explain. The author ascribes the paucity of English visitors at Wildungen to the want of acquaintance of English physicians with the virtues of the waters. But, from whatever cause, mineral springs are not nearly so popular in England as on the Continent, nor as they appear to have been in this country in the last century.

CORRESPONDENCE.

ACCIDENTAL USE OF SULPHIDE OF ANTIMONY.

To the Editor of the Chemical News.

Sir,—In the portion of Dr. Hofmann's "Report on the Development of the Chemical Arts during the last Ten Years" published in the Chemical News, vol. xxxi., p. 221, I observe a statement that accidents have occurred by the accidental use of sulphide of antimony instead of peroxide of manganese in the preparation of oxygen. I can add two instances; one happened to a druggist's assistant in Glasgow, the other to myself. In the latter case, though the materials were purchased at the shop of a thoroughly competent druggist in London, Canada, the mistake occurred of supplying sulphide of antimony instead of peroxide of manganese. I remarked to a friend who was with me while making arrangements for preparing the oxygen, that the manganese looked uncommonly like sulphide of antimony, but, nevertheless, proceeded with our operations. Chlorate of potash and the sulphide of antimony (as I afterwards found it to be by analysis) being mixed in a glass retort, I began to heat gently with a Bunsen lamp, holding the lamp in my hand, and had raised the temperature very slightly, when a violent explosion took place. On examination, I found that the bulk of the retort had been almost pulverised; and my face and the hand which held the lamp were studded with drops of blood from the punctures of small fragments of glass. I had my coat off at the time, and the sleeve of my shirt was set on fire by the explosion. I believe the circumstances of the other case I have referred to were very similar. Had the retort in either case been an iron one, the results would probably have been more serious. It may be worth recording these accidents as a warning to others.—I am, &c.,

Alex. T. Machattie.

88, Hope Street, Glasgow,
May 22, 1875.

FUSING-POINT OF FATS.

To the Editor of the Chemical News.

Sir,—In the Chemical News, vol. xxxi., p. 226, is a report of my short paper on a method for determining the fusing-point of fats. Notwithstanding that in some parts of the text is used the possessive pronoun plural, by some mistake the name of my friend and colleague, Otto Hehner, has been omitted. The paper read before the Society of Public Analysts is in the main a reprint of a chapter published in our little book on "Butter Analysis," and it would be an obvious injustice on my part silently to allow my name to figure alone, above anything approaching an abstract from that our joint work. I therefore beg that you will insert these few lines in your next number.—I am, &c.,

Arthur Angell.

Hants County Laboratory, Southampton,
May 24, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 16, April 26, 1875.

Detection of Ordinary Alcohol Mixed with Wood-Spirit.—M. Berthelot.—The two problems to be solved are—To detect the presence of common alcohol in wood-spirit, and that of wood-spirit in common alcohol. The latter seems solved by the elegant method which MM. Riche and Bardy have this day presented to the Academy (see below), but M. Berthelot thinks it useful to give here the practical solution of the former. The process consists in mixing the suspected liquid with double its volume of concentrated sulphuric acid. In these conditions methylic alcohol yields gaseous methylic ether, entirely absorbable by water or concentrated sulphuric acid, whilst ordinary alcohol produces ethylen, a gas almost insoluble in water and concentrated sulphuric acid, but which may be recognised and determined by causing it to be absorbed in bromine. On operating with the precautions customary in gaseous analysis, the presence of common alcohol may be detected in wood-spirit, even when the proportion does not exceed 1 or 2 per cent. Aceton and the normal impurities of wood-spirit may yield, under these circumstances, carbonic acid and carbonic oxide, but not ethylen.

Cycle Corresponding to the Performance of Thermic Machines with Open Cylinders, and Demonstration of this Cycle, and of the Weight of the Motive Substance Forming the Working Body.—M. A. Ledieu.—Not adapted for abstraction.

Results of Experiments Made by the Commission on the Vine Disease in the Department of l'Herault.—M. Marès.

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Use of Alkaline Sulpho-Carbonates against the Phylloxera.—M. Dumas.—The author considers himself justified in maintaining that the alkaline sulpho-carbonates are a poison for the phylloxera, and that they have no injurious action upon the vines.

Detection and Determination of Methylic Alcohol in Presence of Vinous Alcohol.—MM. A. Riche and C. Bardy.—The wood-spirit used in the adulteration of ordinary alcohol marks 98° on the alcohometer, and its smell and taste are so slight as to escape notice when it is mixed in slight proportions with an alcoholic liquid. If a mixture of alcohol, containing 10 to 15 per cent of this wood-spirit, is distilled, a small quantity of liquid may be separated by means of fractional distillation, which goes over at 78°. The authors at first sought to detect methylic alcohol in this product by transforming it into oxalate of methyl, but without success. They then attempted the solution of the problem by means of the coloured products, differing in shade and stability, which ethyl-aniline and methyl-aniline yield by limited oxidation, and they consider themselves perfectly successful. Introduce into a small flask 10 c.c. of the alcohol, with 15 grms. of iodine, and 2 grms. of red phosphorus, and distil immediately, collecting the product in 30 to 40 c.c. of water. The alcoholic iodide precipitated at the bottom of the liquid is separated by means of a funnel, which is stoppered with the finger, and is collected in a flask containing 6 c.c. of aniline. The mixture grows hot; the reaction is assisted by holding the flask for some minutes in warm water, and moderated by being placed in cold water if a brisk ebullition sets in. After the lapse of an hour, very hot water is poured into the flask to dissolve the crystals formed, and the liquid is brought to a boil until the vessel contains nothing but a clear liquid. To this is added an alkaline solution, which sets free the alkaloids in the form of an oil, which is raised up into the neck of the flask by the addition of a sufficient quantity of water. The oxidation of the alkaloid may be effected by means of perchloride of tin, or, better, by Hofmann's mixture, consisting of 100 grms. of quartz sand, 2 grms. chloride of sodium, and 3 grms nitrate of copper. Of this 10 grms. are taken, upon which 1 c.c. of the oily liquid is allowed to flow, and carefully incorporated by means of a glass rod. The mixture is placed in a test-tube of 2 centimetres in diameter, which is heated to 90° in the water-bath for eight to ten hours. The matter in the tube is then exhausted by three successive treatments with luke-warm alcohol, which is thrown upon a filter, and made up to the volume of 100 c.c. Pure alcohol gives a liquid of a reddish-wood shade. Alcohol containing 1 per cent of methylic spirit gives a solution which appears distinctly violet when compared with the former. At 2·5 per cent of wood-spirit the result is a very decided violet, which is deepened considerably as the proportions rise to 5 and 10. The liquids may be examined colorimetrically, in tubes of the same calibre, being compared with the results with those yielded by mixtures of wood-spirit and alcohol in known proportions. Or swatches of bleached woollen tissues, of equal weights, may be dyed in the liquids. If the alcohol is free from methylic spirit, the wool remains white, whilst samples containing methylic spirit yield violet shades. A single tinctorial assay serves to show whether coloured sugars owe their shade to the natural matter formed during the boiling of the juice or if they have been artificially coloured with coal-tar compounds. We take 8 to 10 grms. of the sugar, and agitate it for about ten minutes with a few centimetres of alcohol mixed with a little ammonia. The solution is decanted, evaporated almost to dryness, the residue taken up in a little water, and a small piece of white merino is suspended in the boiling liquid for some minutes. If the colour is natural, the stuff is not dyed, but if the sugar has been coloured with any coal-tar preparation, it takes a very decided yellow or brown tint.

Vine Districts Attacked by the Phylloxera in 1874. Duclaux.

Precipitation of Silver by Protoxide of Uranium.—M. Isambert.—When metallic oxides act upon solutions of silver salts, the action commonly consists in the precipitation of silver oxide, but there may be produced in some cases a deposit of metallic silver. Ebelmen has shown that protoxide of uranium produces in solutions of nitrate of silver a deposit of metal exactly as does copper, 1 equivalent of uranium replacing 1 equivalent of silver, without escape of gas. On repeating Ebelmen's experiment, the author finds the final result completely exact. Protoxide of uranium being thrown into a very neutral solution of nitrate of silver, and well stirred, a bulky precipitate is formed, whilst the protoxide dissolves, and the liquid becomes green. On continuing to stir, this colour disappears, and is succeeded by a yellow shade, characteristic of the sesqui salts of uranium. At the same time, the precipitate decreases in bulk and changes its appearance, passing from its original state of oxide to that of metallic silver. Hydrated protoxide of iron, in like manner, produces a precipitate of metallic silver, with formation of sesquioxide of iron. This property of protoxides of passing to a higher state of oxidation, and of throwing down metallic silver, is shared by their salts.

Action of Platinum and Palladium upon the Hydrocarbides of the Benzinic Series.—J. J. Coquillion.—In a first series of experiments the author has shown that the vapours of toluen, in presence of an incandescent platinum wire and of atmospheric oxygen, yield, as the result of oxidation, small quantities of hydride of benzoyl and of benzoic acid. He has experimented under the same conditions with other carbides of the same series. With benzin and toluen the quantity of hydride of benzoyl obtained is very slight, benzoic acid predominating. With xylen and cumen appreciable quantities of hydride of benzoyl were obtained, which quickly changed into benzoic acid.

Observations on the Spontaneous Alteration of Eggs.—M. U. Gayon.—A reply to a recent paper by M. Béchamp.

Bulletin de la Societe Chimique de Paris, No. 5, March 5, 1875.

Limited Oxidation of the Carbides of Hydrogen.—M. Berthelot.—Not adapted for abstraction.

Researches on the Relation between the Different Colouring Matters of Madder, and on the Part which they play in Dyeing.—M. A. Rosenstiehl.—(Continuation.) Already noticed in the CHEMICAL NEWS.

Researches on Albumen.—P. Schützenberger.—(Continuation.) According to the author's results, albumen is split up by hydrate of baryta into ammonia, carbonate of baryta, amidic acids of the series $C_nH_{2n+1}NO_2$ from amido-œnanthylic acid to the amido-butyric, into tyrosin, and into amidic acids of a more highly oxygenated character, bordering on the aspartic and glutamic acids. The study of these acids will be undertaken in future communications. In incomplete decompositions intermediate crystalline bodies are obtained, containing less hydrogen than leucin and its homologues.

Certain Purple Colouring Matters Derived from Cyanogen.—M. Gaston Bong.—Reserved for insertion in full.

Action of Certain Monatomic Sodic Alcohols upon Camphor.—M. R. D. Silva.—The author having heated for fifteen hours, at 145° to 150° in sealed tubes, a mixture of mono-bromated camphor and sodic ethylic alcohol in known proportions, obtained, on distilling the products, alcohol, which had been present in excess, a solid crystalline body of a peculiar odour, and which passed over between 220° and 240°, whilst a residue containing bromide of sodium remained in the retort. Mono-bromated camphor is thus attacked by sodic alcohol, with separation either of the elements of a molecule of hydrobromic acid,

without substitution, or of an atom of bromine, with substitution of a residue of equal combining value.

Observations on Urines which Reduce Fehling's Test-Liquid, but do not Deflect the Polarimeter.—M. David.—The author in examining a pathological urine obtained results whieh seemed to indicate 10 to 12 grms. of glucose per litre of urine. Nevertheless, not the slightest deviation was obtained with Laurent's saccharimeter. The death of the patient occurred before the investigation was complete.

Action of Heat on Ordinary Aldehyd.—M. Berthelot.—The author evaporated aldehyd in hydrogen, obtaining a gas formed of 5 volumes of hydrogen and 2 of aldehyd. This mixture was heated to dull redness for half-an-hour. At the end of this time the aldehyd was decomposed into carbonic oxide and formen. A sixth part had resisted decomposition, and another sixth part had disappeared.

Ammoniaco-Magnesian Phosphate.—MM. A. Millot and Maquenne.—When an excess of a magnesian salt is added to a solution of the ammoniaco-magnesian phosphate in citrate of ammonia the whole is precipitated. This property completely justifies the process for the determination of phosphoric acid proposed by Joulie (*Moniteur Scientifique*), but it also shows the impossibility of determining magnesia in the state of ammoniaco-magnesian phosphate in solutions containing citric acid.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 3, 1875.

Contributions to Electro-Dynamics.—F. Zöllner.

Proportion of Temporary Magnetism to the Magnetising Force, and its Relations to the Reciprocal Action of the Metallic Particles.—E. Börnstein.

Remarks on the Treatise of Dr. Streintz on the Supression of the Torsion-Vibrations of Wires.—O. E. Meyer.

Resistance of Transit at the Points of Contact of Metallic Conductors.—F. C. G. Müller.

The Specific Heats of the Elements Carbon, Boron, and Silicon.—H. F. Weber.—(First treatise: the dependence of the specific heat of the isolated elements, carbon, boron, and silicon on temperature.)

Passage of the Rays of Light through a Spectroscope.—J. L. Hoorweg.

Unipolarisable Electrodes.—A. Overbeck.

Conduction of Electricity in Electrolytes.—W. Bietz.

Sequel to Essay on the Apparent Position of a Point of Light Existing in a Denser Medium.—K. L. Bauer.

General Theorems on the Images of Spherical Mirrors and Lenses.—K. L. Bauer.

Theory of the Assimilitative Process in the Vegetable World.—E. von Benkovich.

Simple Procedure for Discovering the Poles of a Bar-Magnet.—C. G. Müller.

Determination of the Speed of Light and the Parallax of the Sun.—A. Cornu.

No. 4, 1875.

Unipolar Electro-Conductivity through Gaseous Strata of Different Conductive Power.—C. Braun.

New Studies on the Currents of the Electric Machine.—F. Rossetti.

Remarks on Helmholtz's Doctrine of Vowels.—E. v. Qvanten.

Specific Heats of the Elements Carbon, Boron, and Silicon.—H. F. Weber.—First treatise: (Dependency of the specific of the isolated elements—carbon, boron, and silicon—on temperature. Conclusion.)

Theory of Anomalous Dispersion.—H. Helmholtz.

Electric Falling Machine.—H. Waldner.

Experimental Determination of Diamagnetism by its inductive Action.—A. Töpler.

Optical Method of Studying the Vibrations of Rigid Bodies.—O. N. Rood.

New Species of Variation-Tones.—V. Dvorak.

Spectrum of the Zodiacal Light.—A. W. Wright.

Remarks on Thomson's Electrometer.—K. A. Holmgren.

Electroscopic Notice.

Reimann's Farber Zeitung, No. 9, 1875.

This number contains a continuation of the article on the new colour, "eosin," which we shall give in full when complete.

There is a notice of the Belville steam-boiler, and its use in dye-works; receipts for an iodine-green on linen yarn: a reddish mode, a cinnamon, and a bluish green on wool; a bismarck on woollen yarns; and a chocolate, a black, and an orange on gloves.

No. 10, 1875.

This number contains complaints of the suicidal competition prevailing among the Berlin dyers; instructions for dyeing a *Vert St. Privat* on cotton yarn; an aniline and a Nicholson blue on silks; a green, a Russian green, an aniline blue, and a Nicholson blue on gloves; a corinth, a cerise, and an olive green on woollen yarn; and a light and dark vat-blue on calico, topped with Nicholson blue.

MISCELLANEOUS.

Popular Science with a Vengeance.—It is one of the most hopeful signs of the times that everybody is now supposed to know a little science. Some of us know a very little. Others know a good deal, but the arrangement is somewhat confused. We scarcely know to which class the compiler of the "Yorkshire Exhibition Guide" belongs. Whatever amount of scientific knowledge he possesses, he certainly has the art of "combining his information," and presenting it to his readers in a fresh, cheerful, and interesting manner. He says:—"A medal and plate formed of the new metal, palladium, will be interesting to scientific men. The discovery of this metal by Professor Graham a few years ago finally settled the long-disputed point as to whether or not the gas hydrogen was a metal. He proved that palladium was simply hydrogen condensed. This may be easily exemplified by placing a piece of the metal under the receiver of an air-pump and exhausting the air. The solid metal at once flies off as a gas, and on re-admitting the air it shrinks again into its former size. The little medal shown contains 100 times its volume of the gas." We will only add, in transferring this gem to our columns, that we hope it is not a fair sample of the teaching at the Leeds Mechanics' Institute—the worthy object for whose benefit the Yorkshire Exhibition is being held.—*Iron*.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of artificial fuel. Hunter Henry Murdock, patent agent, Staple Inn, Middlesex. (A communication from William Charles Arthur Rœttger, Brussels.) July 20, 1874.—No. 2533. This invention relates to the manufacture of artificial fuel from coal-dust, saw-dust, peat, tan, or other matters. According to this invention a hydraulic cement is made from a mixture of ferruginous Tournay lime or its constituents (or lime containing only minute traces of alumina and iron), and silicate of soda, or silicate of potash, with excess of alkali. This cement and powdered unslaked poor lime are added to the coal-dust or other matter and intimately mixed, the mixture being moistened with water, and afterwards pressed into blocks. When these blocks are to be transported to a distance they are hardened by dipping them into a bath of silicate of soda or silicate of potash.

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Improvements in the preparation of phosphate salts. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. July 22, 1874. —No. 2568. The object of this invention is the preparation of phosphate salts suitable for the extraction of ammoniacal compounds, and for the manufacture of manure.

Improvements in the manufacture of prussiate of potash and prussiate of soda, and in the means employed for collecting and utilising the gases and other substances emitted in the manufacture thereof. Samuel Nield and Benjamin Foster, both of Leeds, York. July 27, 1874.—No. 2624. The gases, animal, and other matters are drawn through pipes into a receiver containing a solution of alkali acid, pure water, or their equivalents; after passing through, a deposit is left, consisting partly of animal colouring matter and potash. This deposit is used again, or for dyeing or other purposes.

Improvements in apparatus for receiving and treating human excreta, and in the composition of the disinfecting and deodorising powder used therein. James Alexander Manning, Southampton Buildings, Middlesex. August 1, 1874.—No. 2676. This invention has for its object the sanitary improvement of towns and cities, and of dwellings in country districts, by cutting off all communication between the closets and sewers or cesspools, and the substitution for water closets of dry closets of a peculiar construction and arrangement, whereby the liquid and solid excreta are separated from each other, and collected in separate receptacles along with disinfectants, deodorisers, and absorbents, composed of soot, wood charcoal, seaweed charcoal, animal charcoal, or phosphate of lime, sulphates of manganese and of iron.

Improvements in the manufacture of solvents for certain resins and gum-resins. Murdock Mackay, chemist, Mark Street, Finsbury, London. August 5, 1874.—No. 2709. Adding to methylated spirit (or a mixture of pyroxilic spirit and alcohol) one or other of two certain combinations, and stirring till the spirit becomes milky-white or of a milky appearance, and then adding more of the methylated spirit (or of the said mixture) till it becomes clear. The combinations I term No. 1 and No. 2. No. 1 consists of 1 part of benzoline to 6 parts of mineral or coal naphtha; or 1 part of turpentine to 6 parts of mineral or coal naphtha; or half one part of benzoline and half one part of turpentine may be substituted for one whole part of either. No. 2 consists of 1 part of turpentine to 3 parts of benzoline. The proportions stated may be varied, and in some cases I use mineral or coal naphtha only instead of combination No. 1.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Coal-Gas.—Will any of your readers give me an account of parties who, at various times, have tried the experiment of making their own gas for private use, and whether it is considered practicable in private houses? I would also be glad to know the heating power of creasote over that of coal.—JAMES HOOPER.

Rusting of Iron.—Could any of your correspondents inform me what means should be taken to prevent iron employed in breweries from rusting when in contact with water? Would silicated paints do? Something that does not taste the ale would be required.—BREWER.

MEETINGS FOR THE WEEK.

TUESDAY, June 1st.—Zoological, 8.30.
WEDNESDAY, 2nd.—Microscopical, 8.
THURSDAY, 3rd.—Royal, 8.30.
— Royal Society Club, 6.30.
— Chemical, 8. "On the Effects of Pressure and Cold upon the Gaseous Products of the Distillation of Carbonaceous Shales," by J. J. Coleman. "On the Agricultural Chemistry of the Tea Plantations of India," by Dr. Campbell Brown. "On the Structure and Composition of Pseudomorphic Crystals having the Form of Orthoclase," by J. A. Phillips. "On Nitrosyl Bromide, and on Sulphur Bromide," by M. M. Pattison Muir. "On the Action of Chlorine on Pyrogallol," by Dr. Stenhouse and Mr. Grove. "On some New Derivatives of Alizarin," by W. H. Perkin. "On some Metallic Derivatives of Coumarin," by R. Williamson. "Note on the Action of Chlorine on Acetamide," by Dr. E. W. Prevost. "On the Action of Dilute Mineral Acids on Bleaching-Powder," by Ferdinand Kopfer. "Note on Sulphate of Narceine, and other Narceine Derivatives," by Dr. Wright and Mr. Beckett.
FRIDAY, 4th.—Royal Institution, 8,
— Geologists' Association, 8.

TO CORRESPONDENTS.

J. Walton.—See announcement under the heading "Notes and Queries."

Booth and Garrett (Philadelphia, U.S.A.), *S. Cabot, jun.* (Boston, U.S.A.), *C. A. Bell, W. N. Hartley, J. Steiner.*—Received with thanks.

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THE CHEMICAL NEWS.

VOL. XXXI. No. 810.

DECOMPOSITION OF SALT BY SUPERHEATED STEAM.

By S. CABOT, Jun.,
Boston, U.S.A.

THE apparatus used was a cylindrical stove made of cast-iron pipe, and so arranged that all the doors and the top could be closed by iron flanges and air admitted below the grate through a tube, while the products of the decomposition could be taken out above by another. A hot anthracite fire was kindled (without the use of wood, to prevent any alkaline ashes), and a stream of mixed air and steam was blown in by a very simple little tin injector, formed by inserting a fine jet of steam half way into an open cone of tin in the shape of a funnel. The writer has found by experience that a fire may be kept alive for a long time by the blast of mixed air and steam resulting from such an injector, and believes that, by passing the blast through a sufficiently long iron tube, the air would be sufficiently dry to support combustion for an indefinite length of time, and might be used with advantage in many cases where a blast is required. In this case, however, the steam was a more important ingredient than the air. While the fire was still very hot, and the blast passing through it, about a pound of salt was thrown in at the upper door, which was quickly closed. Volumes of hydrochloric acid streamed from the upper tube and were collected in water and tested. The ashes, upon examination, also were found to be alkaline, as should be the case if the reaction is, as usually formulated—

$$H_2O \text{ and } 2NaCl = 2HCl + Na_2O.$$

Of course, the yield was no approach to the theoretical one, and could not be applied as a technical process.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from page 231).

FOR the same reason, a cheaper oxide, as, for instance, oxide of copper, which Böttger proposes,† offers but little advantage, especially as a higher temperature is required for its decomposition.‡ The trouble of preparing a clear solution of chloride of lime may be dispensed with if, as Stolba suggests, a piece of paraffin of the size of a pea be added to the turbid solution.‖ The thin layer of oil upon the surface prevents frothing. One difficulty yet remains to be removed. Chloride of lime requires considerable quantities of water for solution, and large vessels are, therefore, required for preparing moderate quantities of oxygen. A. Winkler,§ therefore, dispensed with chloride of lime, by using a thick milk of lime with a little salt of cobalt, and treating the mixture with chlorine. By means of this modification, a larger volume of oxygen is evolved with the same vessels, and all danger of frothing over is avoided.

The part played by the metallic oxide in these methods is readily intelligible. It serves as a carrier of oxygen, passing alternately to a higher, readily decomposable, stage of oxidation, and then returning to its original state. The hypochlorous acid of the chloride of lime converts the sesquioxide of cobalt into an unstable cobaltic acid, which is immediately resolved into sesquioxide of cobalt and oxygen—

$$Co_2O_3 + 3[CaCl(OCl)] = 3CaCl_2 + 2CoO_3 = Co_2O_3 + O_3.$$

Thus, one part of the above-stated problem is solved, and the developer of oxygen is re-formed by the very act of developing oxygen. Still the oxygen is obtained, not from the atmosphere, but from the chloride of lime. The solution of chloride of calcium formed must be removed, and replaced by milk of lime. The process, therefore, is not continuous, and in this respect there is still room for economic simplification.

This, also, has been achieved, and by means of experiments which lead us back from the moist to the dry way. Since 1851,* Boussingault has brought baryta into use as a bearer of oxygen, heating it to redness in porcelain tubes, and treating it with moist air free from carbonic acid, by which it is converted into peroxide of barium. By means of a current of watery vapour, it is re-converted into hydrate of baryta, and oxygen is liberated. An addition of lime or magnesia prevents any incipient fusion, and 75 grms. of baryta yield on each operation 4 to 5 litres of oxygen. Gondolo† improved this method in 1868, replacing the porcelain tubes with iron ones, protected by magnesia within and by asbestos without, and laid in suitable furnaces, whose temperature was regulated by dampers, and adding to the baryta a little manganate of potash as well as lime and magnesia. In this manner as many as 122 alternate oxidations and deoxidations were conducted in the same tube. Whether, however, it be due to the high temperature, or to other drawbacks which stand in the way of the industrial application of this method, it has not yet found its way into actual practice.‡

(To be continued).

ON THE PREPARATION OF METALLIC BARIUM.

By SERGIUS KERN, St. Petersburg.

THIS metal is usually obtained in a pure state by the decomposition of barium chloride by means of a strong galvanic current; but this method requiring a powerful battery, is very expensive. For the purpose of studying the properties of barium, the following methods were used:—

1. Metallic barium was obtained by strongly heating barium oxide (BaO) with metallic potassium, from which the barium was extracted by mercury; the received barium amalgam was heated, the mercury distilled over and pure barium was obtained.

2. Barium was also obtained in the form of mercury amalgam by a double decomposition of a concentrated solution of barium chloride in water, and of sodium-mercury amalgam as shown in the equation—

$$(n\,HgNa_2) + BaCl_2 = (n\,HgBa) + 2NaCl.$$

As a small quantity of metallic sodium may remain free during this reaction, it is better to take an excess of barium chloride; in this case a pure barium-amalgam is obtained. The amalgam is quickly washed from the sodium chloride in a cup with water, dried and heated to set free the mercury. A description of this process may be found in every manual of chemistry. It is understood that by washing the barium-amalgam by water we oxidise in the same time the barium, which readily decomposes water, with evolution of hydrogen and formation of barium hydrate (H_2BaO_2); so that if we perform the operation of

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."
† Böttger, *Journ. Prakt. Chem.*, xcv, 375.
‡ Reinsch, *Neue Jahr. Pharm.*, xxiv., 94.
‖ Stolba, *Journ. Prakt. Chem.*, xcvii., 309.
§ A. Winkler, *Journ. Prakt. Chem.*, xcviii., 340.

* Boussingault, *Comptes Rendus*, xxxii., 261 and 821.
† Gondolo, *Comptes Rendus*, lxvi., 488.
‡ Robbin, *Pogg. Ann.*, cxxii., 256.

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washing the amalgam very quickly, even then we loose a considerable quantity of metallic barium. However, this process for obtaining barium is a difficult one; the only modification which may be proposed is to collect as quickly as possible the barium-amalgam, to dry it between filtering paper and to heat it strongly; then the mercury and the sodium chloride in the form of vapours fly away. The specific gravity of the barium obtained by the processes mentioned above was found to be 3·75; it is a whitish metal, slightly volatile; the dry atmosphere has no action upon it, but it is readily oxidised at ordinary temperatures by water, with the formation of H_2BaO_2. The metal seems to be rough and ductile. Ordinary acids attack the metal, with the formation of corresponding salts.

I propose a far easier method, consisting in the preparation of pure barium iodide (BaI_2) and obtaining the barium by the decomposition of the barium iodide by means of metallic sodium. The operation may be divided into two distinct parts.

1. *Preparation of Pure Barium Iodide.*—This salt may be prepared by acting on barium hydrate by iodine; the operation is made in water, slightly heated by a spirit lamp. We obtain then two salts, iodate of barium [$Ba(IO_3)_2$] and barium iodide (BaI_2) by the reaction—

$$6H_2BaO_2+6I_2=5BaI_2+Ba(IO_3)_2+6H_2O.$$

The $Ba(IO_3)_2$ is decomposed into BaI_2 by passing a current of sulphuretted hydrogen through the solution; we obtain then—

$$Ba(IO_3)_2+6H_2S=BaI_2+6S+6H_2O.$$

The barium iodide is filtered from the sulphur, evaporated, and dried.

2. *Preparation of Barium.*—The barium iodide is powdered and mixed with an equivalent quantity of sodium. The mixture is thrown into a covered iron crucible and heated. Strong reaction takes place with the evolution of heat and light; the reaction is a very simple one—

$$BaI_2+Na_2=2NaI+Ba.$$

The pure metal may be extracted from the mixture by means of mercury and distilling the barium-amalgam. By this process the barium was obtained in a more compact mass. In all the experiments a strict analogy was observed between metallic barium and calcium; strontium may be supposed to resemble much these two metals, but the difficulty of obtaining the strontium in a pure state was an obstacle in studying the properties of this metal.

ON THE ACTION OF REDUCING AGENTS UPON NITRANILIDES OF SALICYLIC ACID.

By CHICHESTER A. BELL, M.B.

In CHEMICAL NEWS, vol. xxix., p. 167, and vol. xxx., p. 212, I have described the action of reducents on benzonitranilide and benzonitrotoluide. The experiments there detailed are supplementary to those published some time ago by Hobrecker,* and recently by Hübner and others:† and the joint results furnish perhaps the strongest argument in favour of the "ortho" (using this word in the so-called physical sense) constitution of the recently discovered nitraniline melting at 70°C. Hobrecker and Hübner have shown that nascent hydrogen does not remove the oxygen of the benzoic or acetic radicles, when these are substituted for an atom of typical hydrogen in β nitraniline (para-nitro-amido-benzol), but that a diamine of the form $C_6H_4(NH_2)NH(RCO)$ results—

$$(R=CH_3 \text{ or } C_6H_5);$$

while I have proved that the same holds true for the benzoic derivatives of α (meta) nitraniline and of the nitrotoluidine obtained by partial reduction of solid dinitrotoluol. With regard to this latter it is to be remarked that Wurster (*Berichte*, vii., 148) has proved it to be a methyl derivative of α nitraniline. On the other hand, Hübner states (*loc. cit.*) that when tin and hydrochloric acid act on similar derivatives of ortho-nitraniline (F. P. 70° C.), oxygen free bases of the form

$$C_6H_4\begin{cases}NH\\N(RC)'''\end{cases}$$

are at once formed without any intermediate product. These he has termed anhydro-acetyl and anhydro-benzoyl-diamido-benzol.

Assuming, then, the existence of a benzol "ring," these remarkable differences can be most naturally referred to the proximity, or ortho position, of the nitro and amido groups in the latter nitraniline; for, according to present views, the three points of attraction of the reduced acid radicles CH_3-C''' and C_6H_5-C''' belong in each case to one carbon atom, which must therefore stand in direct relation with both nitrogen atoms in the diamines. This, we may presume, could only be possible in an ortho diamine. The reasoning here is precisely similar to that by which phthalic acid is regarded as an ortho derivative. As is well known phthalic acid readily yields an anhydride

$$C_6H_4\begin{cases}CO\\CO\end{cases}>O,$$

while its isomers, terephthalic and isophthalic acids, do not.

With the object of contributing additional proofs in support of these views, I have examined the action of reducents on the α and β nitranilides of salicylic acid. The former of these nitramides has already been obtained by Wanstrat* by the action of phosphorus trichloride on a mixture of salicylic acid and metanitraniline (from common dinitrobenzol). To the description of it which he has given I have only to add that it possesses well-marked acid properties, dissolving in cold dilute alkalies; from these solutions it is again precipitated by acids. It also decomposes sodium carbonate at a boiling heat to form a crystallisable sodium compound. Advantage may be taken of this property to purify it from a black substance which sometimes accompanies it, and which cannot be removed by crystallisation. Although very sparingly soluble in cold alcohol, it is abundantly taken up by alcoholic ammonia: but on evaporation the ammonia is entirely expelled. It is best crystallised from glacial acetic acid.

By tin and hydrochloric acid it is slowly dissolved, a crystalline double salt separating on cooling. This must be re-dissolved by addition of water, and the liquid freed from tin by sulphuretted hydrogen. To the filtrate from the tin sulphide potash must be cautiously added, as the precipitate at first formed is readily soluble in excess. The resinous mass thus obtained must be repeatedly crystallised from boiling water, with addition of animal charcoal. The same compound is more readily formed by treating the alcoholic ammoniacal solution of the nitranilide with sulphide of hydrogen. The residue left on evaporation may be at once crystallised from boiling water. From this the base is deposited in colourless micaceous crystals, fusing at 143° C. It is slightly soluble in cold water, very soluble in alcohol. Analysis agreed closely with the formula $C_6H_4(NH_2)(NH,C_7H_5O_2)$. It is not only a powerful base yielding sparingly soluble salts with acids, but it also dissolves readily in alkalies, even in very dilute aqueous ammonia. This latter solution, freed from excess of ammonia by standing over sulphuric acid, gives precipitates with salts of the heavy metals. On evaporation the ammonia is completely expelled. The acid properties in these and the following compounds are manifestly due to the hydroxyl of the salicyl radicle, $C_6H_4(OH)CO'$.

The para (formerly ortho) isomers of the foregoing compounds are easily obtained by similar processes from para-nitraniline (fusing-point 146° C). The paranitranilide of salicylic acid, even after repeated crystallisations from

* *Berichte der Deutsch. Chem. Gesell.*, 1872, 920.
† *Berichte der Deutsch*, 1873, 798 and 1128; 1874, 1314; 1875, 471.

* *Berichte*, 1873, 336.

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alcohol, forms slightly brown flaty crystals, insoluble in boiling water, but much more soluble in alcohol and acetic acid than the corresponding metanitranilide. It melts at 229°–230° C., while the *α* compound melts at 218°–219° C. In other respects the two are very similar. Its analysis agreed accurately with the formula $C_6H_4(NO_2)(NH,C_7H_5O_2)$.

Even after prolonged treatment of a solution of it in alcoholic ammonia with sulphide of hydrogen, the greater part of the base is unaffected, only a small portion being converted into brown resinous products. By tin and hydrochloric acid with some alcohol it is quickly dissolved, and the solution deposits on cooling a crystalline precipitate containing but little tin. From this it may be freed by treating its alcoholic solution with sulphide of hydrogen. To the filtrate from the tin ammonia is added in slight excess, and the whole brought to dryness on the water-bath. The ammoniacal compound at first formed is thus decomposed, and the residue, consisting of the free base and ammonium chloride, may be at once crystallised from boiling water. Thus obtained, salicyl-paraphenylen-diamin crystallises in brilliant pale straw-coloured needles, which melt at 158° C. Its analysis agreed fairly with the formula

$$C_6H_4(NH_2)(NH,C_7H_5O_2).$$

By way of control a portion was converted into a platinum salt. Found 22·22 per cent Pt; calculated for $2(C_6H_4(NH_2)NH,C_7H_5O_2.HCl).PtCl_4 = 22·69$. From its meta-isomer it is distinguished by its very slight solubility even in boiling water and by its feeble basic properties. It is unaffected by dilute acids, but dissolves readily in very dilute ammonia. From this solution hydrochloric acid precipitates a very sparingly soluble hydrochlorate.

The reduction of the ortho-nitranilide would be of peculiar interest, for the hydroxyl group of the salicylic acid, in consequence of its ortho position, might enter into the reaction. I have not yet succeeded in obtaining it by the action of nitric acid on the anilide.

Steevens's Hospital Laboratory, Dublin.

LABORATORY NOTES.

By THOMAS GARSIDE, F.C.S.

1. *Colour produced by Nessler Test in Water containing Soluble Sulphides.*

If Nessler test is added to water free from ammonia, but containing hydro-sulphuric acid or an alkaline sulphide, the colour produced is identical with that given by ammonia, provided the quantity does not exceed what is necessary to produce a colour equal to 0·05 m.grm. of ammonia in 50 c.c. water. Above this the colour becomes blacker, and very soon the precipitating point is reached. The effect may easily be distinguished from that produced by ammonia, as it does not disappear on neutralising with hydrochloric acid. If the two occur together, the difference in colour before and after the addition of hydrochloric acid will serve to show the amount of ammonia present. Under certain circumstances this might perhaps be made available for the estimation of minute quantities of sulphides and sulphites.

2. *Action of Nessler Test on Rain-water.*

Whenever I have applied the Nessler reagent direct to rain-water, there has invariably been produced a *muddy* appearance. Thinking that this might be owing to impurities derived from neighbouring chimnies, I collected some rain-water on the roof of the Southport Meteorological Observatory, which is situated at some distance from any houses, but without perceiving any difference in the result. When distilled the distillate gives the usual clear brown colour. I have not yet been able to find any explanation of the phenomenon.

3. *Occurrence of an Intermediate Frothing Point in Determining the Hardness of certain Waters.*

I have frequently noticed in applying the soap test to waters containing rather a large proportion of magnesium salts, that a slight froth begins to form which gradually increases in tenacity until nearly sufficient soap test has been added to precipitate all the lime. At this point it is sometimes so permanent as to cover the whole surface of the liquid for five minutes. On continuing the addition of the soap test, however, the disappearance of the froth again becomes sharp and decided.

4. *Action of strong Sulphuric Acid, Sp. Gr. 1·843, upon certain Salts.*

When 14 parts of *baric sulphate* were added to 100 parts of sulphuric acid, and the mixture rubbed against the sides of the test-tube with a glass rod, a nearly clear solution was effected after some time. When the temperature of this was raised to 100° C., needle-shaped crystals were produced in large quantity; at 160° to 180° these entirely disappeared, but others of prismatic shape began to form, and increased in quantity as the temperature approached the boiling-point of the acid. At a boiling heat 100 parts of the acid retained between 8·5 and 9 parts of the salt in solution. When the mixture was cold, the whole of the salt re-dissolved upon stirring, and a perfectly clear solution was obtained.

The needle-shaped crystals which formed at 100° did not re-dissolve in the cold acid.

Strontic sulphate was soluble to the extent of 14 parts in 100 parts of acid at 70° C. If the temperature was lowered from this point, tabular rhombic crystals were produced; if it were raised, others having the form apparently of cube and octahedron were deposited.

Anhydrous *calcic sulphate* added to sulphuric acid in the proportion of 8·25 parts to 100, was converted at 15° C. into needle-shaped crystals. These disappeared and complete solution was effected at about 70° C. On continuing to raise the temperature, at a little over 100° C., crystals of various shapes were deposited; these again disappeared at 160° C. to 180° C., but were again thrown down at 200° C. and upwards.

Lead sulphate was soluble to the extent of 1·5 parts in 100 of boiling acid. When cold a few crystals were deposited, and 1·15 parts retained in solution.

THE CHEMICAL CONSTITUTION OF THE ETHYL-ETHER AND ITS CHLORINATED DERIVATIVES,

VIEWED AND INTERPRETED FROM THE STANDPOINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

THE profound and extensive researches of Professors Jacobsen, Lieben, Abeljanz, and other distinguished analysts into the molecular structure of the ethyl-ether and its chlorinated derivatives have brought to light a great variety of striking experimental evidence, from which it is argued by Lieben and a number of those chemists who are accustomed to ponder and interpret chemical phenomena from the standpoint of the prevailing type-radical theory, that the substituted chlorine molecules are not symmetrically distributed between the two ethyl radicals which, it is maintained, are co-existing as such in the ethyl-ether. This notion of a dis-symmetrical distribution appears to derive great weight from a group of observations, all tending to the general conclusion that the five component hydrogen molecules of one of these ethyl radicals admit of being replaced by chlorine at easily realisable temperatures, while the five component hydrogen

molecules of the other ethyl radical can be made to do so under the powerful influence of solar agency only. Having studied this case by the new light of my "typo-nucleus" theory, and sincerely believing that my speculative labours have been crowned with the desired success, I have deemed it my duty to submit the first fruits of these labours to the ordeal of a severe, but candid and impartial criticism. I may state beforehand that the majority of the compounds commented upon in the sequel belong to the prolific family of the acetals, whose parent molecule, the ethyliden-glycolic alcohol, remains yet to be discovered.

Having now conducted the reader to the threshold of that particular compartment of organic chemistry which has served to furnish so many precious materials for carrying out the design of the present communication, I shall at once proceed to acquaint him with the leading topics of my programme, which consists of two parts. In the first part, I shall expound the molecular changes that accompany the formation of the mono- and dichlor-ethyl-ether, and dilate on the various metamorphoses which these substances are prone to experience under the influence of water or strong potash-lye. In the second part, I shall elucidate the action of sodium ethylate on the chlorinated ether and acetal derivatives, and enquire likewise into the mode of formation and molecular structure of the ether salts of ortho-formic and ortho-carbonic acids. Let us, then, enter upon the discussion of the proposed theme by examining into the leading topics of the first part of my programme.

Part I.

On the Principal Molecular Changes attending the Formation of the Mono- and Dichlor-Ethyl-Ether, as also on the various metamorphoses which these substances are prone to experience under the influence of Water or strong Potash-Lye.

According to Jacobsen, the first product of the action of free chlorine on the ethyl-ether is the monochlor-ethyl-ether, to which I assign the formula*—

$$\begin{matrix} Et_2O_2. \\ Fo_2Cl_2,Me_2O_2. \end{matrix}$$

This formula is based upon the reasonable hypothesis that the originally-formed mono-chlor-ethyl-ether proper, Et_2O_2, is, from its want of stability, speedily made to merge into the isomeric ethyliden-oxychloride—

$$FoCl_2,Me_2O_2,$$

which, by combining, on the part of its principal, with a molecule of unaltered ethyl-ether, gives rise to Jacobsen's compound. Upon this view, the general correctness of which I hope to demonstrate in the sequel, it will be seen that the primary chlor-ethyl-ether comports itself precisely like the similarly-constituted chlor-ethyl-chloride, E_2Cl_2, which, from its great readiness to pass into the isomeric ethyliden-dichloride, Fo_2Cl_2,Me_2Cl_2, is likewise unknown to us in the primitive form. On subjecting his chlor-ethyl-ether to the action of water, a product was obtained to which Jacobsen applied the term "aldehyd-alcoholate," and which is evidently—

$$\begin{matrix} H_2O_2.\ Et_2O_2. \\ Fo_2O_2,Me_2O_2, \end{matrix}$$

showing it to be the mono-ethyl-ether of the missing ethyliden-glycolic alcohol, while the ordinary acetal—

$$\begin{matrix} Et_2O_2.\ Et_2O_2. \\ Fo_2O_2,Me_2O_2, \end{matrix}$$

is its di-ethylic derivative. In turning to the bichlor-ethyl ether—

$$\begin{matrix} Et_2O_2. \\ Fo_2Cl_2,Me_2O_2, \end{matrix}$$

the chief decomposition products and derivatives which, according to Lieben and Abeljanz (*vide* their respective memoirs), that substance is known to yield, in contact with water or strong potash-lye, are found to be the hydroxyl-chlor-ether in two isomeric modifications, chlor-acetaldehyd, oxy-acetaldehyd, and ethylic alcohol (I shall pass over a condensation product of the hydroxyl-chlor-ether).

It is of importance to bear in mind that the two modes of treatment just alluded to give the same products, although in different quantitative proportions; so that the explanations I am now going to offer in connection with the second of these modes will apply equally well to the first also.

According to Abeljanz, the direct products of the action of strong potash-lye on the bichlor-ethyl-ether are chloride of potassium and the hydroxyl-chlor-ether; but, considering that this ether occurs in the two isomeric modifications—

$$\begin{matrix} H_2O_2.\ Et_2O_2. \\ \alpha)\ Fo_2Cl_2,Sfo_2O_2\text{–}Sfo_2O_2 \end{matrix}$$

and—

$$\begin{matrix} H_2O_2.\ Et_2O_2. \\ \beta)\ Fo_2O_2,Me_2O_2, \end{matrix}$$

it becomes incumbent on me, in justification of these formulæ, to define the precise character of the two kinds of chemical action which the alkali is held to exercise on the bichlor-ethyl-ether. If, then, a chlorine-coveting substance, like hydrate of potash, for example, is brought to bear upon a compound where, as in the case before us, the two substituted chlorine molecules belong to two locally and typically distinct groups, in which they are destined to discharge different duties and functions, the following two alternatives present themselves for our consideration.

In the first alternative, the bichlor-ethyl-ether, in virtue of a purely catalytic action on the part of the alkali, is first made to pass into the isomeric modification—

$$\begin{matrix} Et_2O_2. \\ Fo_2Cl_2,Sfo_2Cl_2\text{–}Sfo_2O_2, \end{matrix}$$

where the molecular changes consist in the splitting up of the chlor-methylen adjunct into hydrochloric acid and four uniovalent carbon molecules, two of which are appropriated by the acid, when the resulting semi-formyl-chloride, by allying itself with the remaining semi-formyl-oxide, gives rise to a molecule of the biatomic methylen-oxychloride, which, in conjunction with the originally-existing formyl-chloride and ethyl-ether, completes the formation of the compound in question.

Now, it is from this modification that the α-hydroxyl-chlor-ether is finally produced, by the interchange of the semi-formyl nucleus of the principal for the potassium nucleus of the hydrate. In the second alternative, the unaltered bichlor-ethyl-ether, by the interchange of the formyl nucleus of the colligated formyl chloride for the potassium nucleus of the hydrate, gives at once rise to a molecule of the β-hydroxyl-chlor-ether.

In pondering the molecular changes that ought to accompany the catalytic action of the alk[illegible] the

* The marks of punctuation are symbols of molecular grouping. Thus, a dot connects a base with its acid; a semi-colon, the hydrocarbon adjunct with its principal; and a comma, the halogen adjunct (which may be a mono- or poly-atomic acid, base, or salt) with its principal. In the chemical formulæ (generally the double of the ordinary formulæ) the non-essential constituents are placed above the essential constituents, while the notation is simplified by means of symbols representing hydrogen and bicarbon nuclei variously modified by their chemical union with different hydrocarbon adjuncts. These nuclei must not be confounded with the compound radicals of the dominant system, with which they have nothing in common but the names. Dashes placed above these symbols indicate the number of substituted chlorine molecules in the associated hydrocarbons. The following is a list of the symbols embodied in the formulæ of the text:—(1) Formyl in the two isomeric modifications, $Fo_2=2C_2;H_2$ and $2Fo=2H;2C_2$ (chlor-formyl: $2Fo=2Cl;2C_2$) ÷ (2) semi-formyl: $Sfo_2=2C;H_2$ ÷ (3) methyl: $Me_2=2H_2C_2;H_2$ (chlor-methyl: $Me_2=2HC_2Cl;H_2$ ÷ dichlor-methyl: $Me_2=2C_2Cl_2;H_2$) ÷ (4) ethyl: $Et_2=2H_4C_4;H_2$ (chlor-ethyl: $Et_2=2H_3C_4Cl;H_2$). $H_2=2;C_2=12;O_2=16$.

β variety, I have, further, been led to infer the existence of a γ modification—

$$\begin{matrix} H_2O_2. & Et_2O_2. \\ Fo_2O_2,Sfo_2Cl_2\text{–}Sfo_2O_2; \end{matrix}$$

and, finally, as regards the end-product of the continued action of the alkali on either of these three varieties, I have no doubt but that it will be found one and the same, viz., the ethyl-ether of the triatomic ethyliden-glycolic alcohol—

$$\begin{matrix} H_2O_2.\ H_2O_2. & Et_2O_2. \\ Fo_2O_2,Sfo_2O_2\text{–}Sfo_2O_2. \end{matrix}$$

It is upon the basis of the preceding formulæ that the simultaneous occurrence of chloracetaldehyd—

$$\begin{matrix} H_2O_2. \\ Fo_2Cl_2,2FoO, \end{matrix}$$

and oxy-acetaldehyd—

$$\begin{matrix} H_2O_2.\ H_2O_2. \\ Fo_2O_2,2FoO, \end{matrix}$$

on the one hand, and of ethylic alcohol on the other hand, may be satisfactorily explained by the splitting-up of the α and γ varieties of the hydroxyl-chlor-ether, the former into ethylic alcohol and the ordinary chlor-acetaldehyd, and the latter into ethylic alcohol and an isomeric modification of chlor-acetaldehyd—

$$\begin{matrix} H_2O_2. \\ Fo_2O_2,Fo_2Cl_2, \end{matrix}$$

from which the oxy-acetaldehyd is then finally produced with the aid of two molecules of water, it being taken for granted that the resulting deglycolic alcohol—

$$\begin{matrix} H_2O_2.\ H_2O_2. \\ Fo_2O_2,Fo_2O_2, \end{matrix}$$

is very prone to merge into the isomeric oxy-acetaldehyd. In this view I am further confirmed by the behaviour of a concentrated solution of sulphate of water—

$$\begin{matrix} 2H_2O_2. \\ 2S_2O_6, \end{matrix}$$

towards the β-hydroxyl-chlor-ether; for it appears to me that the simultaneous production of sulpho-vinate of water—

$$\begin{matrix} Et_2O_2.\ H_2O_2. \\ 2S_2O_6, \end{matrix}$$

oxy-acetaldehyd, and hydrochloric acid must be due to the interchange of one of the two basic hydrogen nuclei in the sulphate for the ethyl nucleus of the β-hydroxyl-chlor-ether, which gives rise to the sulpho-vinate and the combination—

$$\begin{matrix} H_2O_2. & H_2O_2. \\ Fo_2O_2,Sfo_2Cl_2\text{–}Sfo_2O_2 \end{matrix}$$

(derived from the previously-formed γ-hydroxyl-chlor-ether). But this compound is soon made to resolve itself into two molecules of water and the aforesaid variety of chlor-acetaldehyd, from which the oxy-acetaldehyd has just been said to emanate.

When, afterwards, a portion of the aldehyd, as obtained in one of these experiments, was transferred to the exsiccatory apparatus, and left to absorb oxygen from the air, the entire absence of the ordinary chlor-acetaldehyd was proved by the circumstance that the resulting glycolate failed to give the slightest indication of the needle-shaped crystals of the looked-for chlor-acetate. Nevertheless, the remaining portion of oxy-acetaldehyd, on being heated with water and oxide of silver, was observed to furnish, in addition to the bright mirror of reduced metal, a very perceptible quantity of chloride of silver.

Now it strikes me that these unexpected, and otherwise unintelligible, deviations are readily explained on the assumption that this specimen of oxy-acetaldehyd had yet been containing a small admixture of our variety of chlor-acetaldehyd, which, from its chemical constitution, ought to be perfectly passive to atmospheric oxygen; whereas the ordinary chlor-acetaldehyd, through its formous acid principal, ought to evince, as it does, in fact, a powerful attraction for that element.

With these few theoretical hints and considerations, I shall now embark in the discussion of those weighty matters that are reserved for the second part of my programme.

(To be continued.)

PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

On Wednesday last, the 2nd inst., a general meeting was held at Cannon Street Hotel, when the chair was taken by Mr. J. A. Wanklyn, M.R.C.S., one of the Vice-Presidents.

The minutes of the last meeting having been read and confirmed, the Council presented a report on the "Sale of Food and Drugs Bill," showing the amendments it had undergone since the last meeting of the Society.

Immediately following this, Mr. Wigner read a paper indicating the points of similarity and divergence between the old Bill and the new, and explaining the probable working of the one as compared with the other.

Considerable discussion followed, in which Messrs. Bernays, Dupré, Allen, Tripe, and several other Members took part.

Resolutions were passed instructing the Secretaries again to communicate with the Local Government Board, or to take such other steps as they should think advisable, with a view of obtaining a modification of some objectionable features still remaining in the Bill.

The following gentlemen, whose names had been printed with the circular convening the meeting, were declared by the Scrutineers appointed to examine the voting papers to have been unanimously elected as Honorary Members:—F. A. Abel, F.R.S., President of the Chemical Society; E. Frankland, F.R.S., D.C.L., &c.; W. Odling, M.B., F.R.S., &c.; A. W. Williamson, Ph.D., F.R.S., &c.

The Secretary then announced that the Council, feeling the deep obligation which the Society owed to the Right Hon. Dr. Lyon Playfair, M.P., and Dr. Chas. Cameron, M.P., for the strenuous and successful exertions which they had made in the House of Commons for the improvement of the "Sale of Food and Drugs Bill," recommended that the names of those two gentlemen be added to the list of Honorary Members, and that they be balloted for there and then.

The ballot was immediately taken, and the two gentlemen named were unanimously elected.

After this, several papers were read and discussed, but we are compelled to defer a fuller report till a future occasion.

NOTICES OF BOOKS.

Introduction to Experimental Physics, Theoretical and Practical: Including Directions for Constructing Physical Apparatus and for making Experiments. By Adolf F. Weinhold, Professor in the Royal Technical School at Chemnitz. Translated by Benjamin Loewy, F.R.A.S. London: Longmans and Co. 1875.

This work is principally interesting to the chemist from the fact that it discusses a great quantity of physical work, more or less assimilable with his own work in a chemical laboratory. Yet it is not a treatise on physical manipulation alone, like the works of Kohlrausch and Pickering, which pre-suppose a knowledge of general physics, but our author has rather permitted the book

study and the practical work to go hand in hand, so that his work might almost be put into the hands of a beginner. He tells us how we may improvise numberless pieces of apparatus for which we are in the habit of paying high prices at the instrument makers, and which we never dream of making for ourselves. Practical advice is given about drilling, screw cutting, turning, &c., and a description of the various tools required. In the case of nearly all the numerous woodcuts the scale is given—"one-fourth real size," "one-eighth real size," and so on. Although the work is quite free from mathematical formulæ, a great number of simple calculations are worked out, such as the calculation of the velocity of light from the eclipses of Jupiter's satellites; and the determination of the relative intensity of different sources of light by means of Rumford's photometer. In the use of the latter the author remarks "An insurmountable difficulty in these experiments arises from the fact that two sources of light never emit light which is of equal whiteness. The light of a candle is always somewhat more reddish than that of a paraffin lamp; hence the shadow projected by the lamp—that is the portion solely illuminated by the candle—has a more reddish tinge than the other shadow, and in consequence of this difference in the colour of both shadows it is impossible to decide whether both are equally illuminated."

The work does not contain the most recent forms of apparatus in many instances; thus Winter's electrical machine is described at length, but no mention is made of the machine of Holtz or Bertsch; neither do we find mention of Thomson's galvanometer, and many other instruments. The book must not be regarded as a complete handbook of physics, but must be used with some one or other books; or better it should be worked through, and then supplemented by such a work as Deschanel. Even such important laws as Ohm's law, and Faraday's law, are no more than mentioned, and one is sometimes tempted to wonder how the 839 pages have been filled, did we not observe the minute directions which are often given for the performance of an experiment. These are sometimes almost too minute, unless the book is regarded as a text-book for those who are absolutely commencing experimental work; for example, our author writes: "Care is required in handling the acid; if a drop should get on to the clothes it should be immediately touched with solution of ammonium carbonate, which it is best to have in readiness; for as soon as the spot becomes visible it is not easy to remove it. The hands are coloured yellow by nitric acid, and the colour disappears only gradually as the destroyed skin peels off and is replaced by a new growth underneath it.

Still we commend the book to the notice of all students who are doing practical physical work; it abounds with useful hints; and we specially commend Prof. Foster's preface, which contains much valuable and suggestive matter.

The Commercial Handbook of Chemical Analysis. By A. Normandy. New Edition; enlarged, and to a great extent re-written, by Henry M. Noad, Ph.D., F.R.S. London: Lockwood and Co. 1875.

There are few chemists who are not acquainted with the "Handbook of Commercial Analysis," written by Dr. Normandy, which was published in 1850, and when, ten years later, the publishers announced the appearance of a new edition, many were the regrets of those who found they had purchased an exact reprint of the original work. Such a real want existed for a work of the nature of Dr. Normandy's Chemistry—but brought carefully up to the present time—that we hailed with especial satisfaction the announcement that the compilation had been undertaken by a chemist of so high a reputation as Dr. Noad.

In the work under notice, the editor has retained the alphabetical arrangement of the first edition, but the articles have been revised, and much new matter has been introduced.

In his preface, Dr. Noad states that he has endeavoured to make the work a "Handy Book" for the efficient analyst discharging his duties under the new Adulterations Act, and therefore special interest attaches to the sections having reference to articles which come under the notice of the public analysts, and to which the editor directs attention in his preface.

In the article on bread the editor gives instructions for detection of alum, which are shortly as follows:—The bread is to be charred in platinum—carefully avoiding incineration. The charred mass is to be powdered, boiled with aqua regia, and the whole evaporated to dryness. When dry, the mass is to be boiled with concentrated solution of soda, and the solution filtered. The filtrate is neutralised with hydrochloric acid, sodium phosphate added, and then ammonia in slight excess, the resultant phosphate of aluminium being weighed. It would not be difficult to find fault with the above process on more than one ground, but the uncertainty of effecting solution of the alumina, and the liability to get silica dissolved, would make any experienced analyst very chary in relying upon results given by it, though the editor expresses his indebtedness to Dr. Tidy for the details of the method.

Under the head of butter, the author gives Dr. Campbell Brown's process in full, and a detailed description of Mr. Allen's method of examining tea is to be found under the appropriate head.

Wanklyn's process of examining milk being now in almost universal use, we are astonished to find that the author ignores it entirely, but gives a detailed description of the old analyses of Dr. Voelcker of the milk at Cirencester. When we find that the latter chemist's notorious assertion that "milk purposely watered yields only 5 to 6 per cent of cream, and invariably has a lower specific gravity than 1·025" (!) is quoted as gospel, we cannot but feel that the much-talked-of discrepancies of chemists are often due to causes for which the leaders of the profession are responsible.

Perhaps one of the worst articles in the book is that on coffee, a considerable part of which consists of useless "padding," while true scientific information is conspicuous chiefly by its absence. For the detection of chicory, the editor appears to rely on the "cold water test," the separated chicory being "identified by its taste and pastiness," no hint at a microscopic examination being given, and no mention of the normal percentage of ash in coffee being made. Nor is there any reference to the classical report of Messrs. Graham, Stenhouse, and Campbell, or to their infusion or colour tests.

It might be expected that a work which deals with frankincense, glue, lozenges, and stick-lac, would at least treat of such everyday subjects as slags, oil-cakes, anthracene, mustard, coal, coke, petroleum, fire-clays, &c., to none of which is any reference made—though there is an appendix treating of articles accidentally omitted from the text of the book.

Having found so much occasion for adverse criticism, it is pleasant to be able to write in commendation of many excellent articles in the book, and of the general plan of arrangement. Symbols have been entirely avoided, while the compromise between the old and new nomenclature, by which chalk is called carbonate of calcium, is well adapted to meet the requirements of all classes of chemists. There is a useful glossary, which is in effect a short treatise on chemical manipulation, illustrated with some useful woodcuts.

On the whole, we can recommend the book as containing a great deal of information of a kind not readily met with, and the want of a first-rate book of the sort is so widely felt, that we trust the editor may see his way at an early date to compile an appendix treating of articles hitherto wholly omitted or but imperfectly dealt with in the present edition.

CORRESPONDENCE.

WATER ANALYSIS IN THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—In the condition into which it has fallen, the Chemical Society of London interests me very little, and, as a rule, I pay little attention to its proceedings.

But from the last Chemical News I learn that water analysis has been before the Society, and that a variety of misrepresentations have been made.

Possibly it may be well to correct these, and I take this opportunity of doing so.

The occasion which brought water analysis before the Society was the reading of a paper by Mr. Deering "On some Points in the Examination of Waters by the Ammonia Method," and the ammonia method (or process) of water analysis, as I need hardly say, was discovered by Chapman, Smith, and myself, eight years ago.

The first commentary that I have to make on Mr. Deering's paper is that I have difficulty in perceiving the novelty in it. That the Nessler colour takes some time to develop has been often remarked, and that by observing certain precautions in the preparation of the reagent, and in the manner of working the test, any difficulty on that score may be got over is likewise well known to many persons, but apparently not to Mr. Deering, who in this paper proposes to get over the difficulty by the use of a solution of caramel to imitate the Nessler colour. Even this proposal is not new, caramel having been used for the purpose before, and, I believe, abandoned.

That peaty waters yield albumenoid ammonia in considerable quantity is quite well known, and has been pointed out in the third edition of my book on "Water Analysis," which was published about a year ago. That there is any difficulty in distinguishing between such cases and the cases in which town sewage exists in drinking waters (which Mr. Deering appears to imply) is not true.

The commentaries on Mr. Deering's paper were just what I should have expected from the Chemical Society in its present condition. There was a caution from Mr. Hartley to keep the Nessler cylinders closed during the distillation, lest they should absorb ammonia, which he thinks might enter them even although "there might be no odour of ammonia in the room." This caution will amuse persons who have practical acquaintance with the subject, and who know that—although every vessel should be washed with abundance of water immediately before being used—yet even when there is a powerful smell of ammonia in the laboratory, there is little danger in Nesslerising in open cylinders. Another person said he had examined peaty waters, and got much albumenoid ammonia from them: but no one appears to have called attention to the circumstance that in the instance of vegetable contamination there is comparatively little free ammonia and much albumenoid ammonia, whilst in town sewage—even when highly diluted—the ratio is reversed. Neither did anyone refer to the evidence derivable from the chlorides. I have long ceased to expect anything like "insight" in the Chemical Society, and am not surprised that no one remarked on the "different distribution" of the albumenoid ammonia according to the nature of the organic substance which is present, and that this difference is especially marked between such substances as animal albumen and vegetable substances.

The observations by the President, Mr. Abel, are characteristic. I remember well, soon after we had brought out the ammonia process (which so many persons have found so very easy, so very certain, and so very regular), that Mr. Abel got up to tell the Society that he could not work it at all, and that he experienced the greatest difficulty even in the operation of Nesslerising. Remembering this, I am not surprised—now that Mr. Abel occupies the President's chair—that he should find the existence of peaty matters in drinking-water a source of difficulty in the working of our process; but I do not think that the fault lies with the process.

The President's concluding remark is equally characteristic. He said, "He agreed with Mr. Thorp that the combustion method in some cases possessed considerable advantages over the Nessler test." In order that this may be intelligible it is necessary to explain that when certain chemists have occasion to speak of the process of water analysis, discovered by Chapman, Smith, and myself, they are in the habit of calling it the Nessler test, or the Nessler process. Whether, in so designating it, they are influenced by the love of brevity, or confusion, or by some other motive, need not be discussed; suffice it to note the peculiarity of expression, and to explain that the President meant that in some cases Dr. Frankland's process of water analysis will answer, and ours will not.

The defects in Dr. Frankland's water analysis were pointed out by Chapman, Smith, and myself in the year 1868, when we showed that Dr. Frankland's process is affected by such serious error as to be quite illusory. No reply has yet been made by Dr. Frankland, who was present at the meeting of the Society in which we brought forward our criticisms; and, so far as I am aware, instead of being prepared with answers to these criticisms, chemists are inclined to wonder that it should have been necessary for us to point out, in such minute detail, defects which were so very palpable.

That, in the year 1875, the person who occupies the chair at the Chemical Society should affirm the validity of Frankland's water analysis shows that our criticisms were not superfluous, and call upon us to repeat them.

Dr. Frankland's process of water analysis professes to determine the quantities of carbon and nitrogen existing in the form of organic compounds in drinking-water, and consists in making an elementary organic analysis of the solid residue left on evaporating the water to dryness in the water-bath.

In limine, there is a very obvious objection to this procedure; viz., that the organic matters present in water are alterable by prolonged exposure to the action of air and moisture at the temperature of the water-bath, and that therefore the carbon and nitrogen which Dr. Frankland's process professes to measure in the form of carbonic acid and nitrogen gas, are allowed to make their escape into the atmosphere, in various shapes, during the evaporation to dryness. When the extreme minuteness of the organic matters existing in drinking-waters is considered, and the extreme alterableness of some of them, the invalidity of the process must be quite apparent.

Looking into the subject more closely, we find almost every conceivable reason for distrusting the results. Nitrates are common in drinking-water, and, compared with the organic matter, are present in abundance, ten times as much nitric acid as organic matter being of common occurrence. In order to avoid confounding the "organic" nitrogen with the nitrogen of the nitrates, Dr. Frankland proposes to destroy the nitrates by boiling with some sulphite of soda, which he adds in the shape of sulphurous acid and carbonate of soda. But there is this difficulty to be encountered. The nitrates are not perfectly reduced unless the solution be acid; and if the solution be rendered acid, then sulphuric acid is produced, and Dr. Frankland thereby guarantees himself against all chances of correct results; for if, perchance, the organic matter in any instance should survive the operation of being heated for several hours in contact with air and moisture, he destroys it with sulphuric acid, which must become concentrated as the water residue approaches to dryness.

Dr. Frankland's water process belongs to the class of analytical methods which are affected with a high experimental error; indeed, it is quite unique in this respect, inasmuch as the experimental error amounts to about ten times the quantity to be measured. Dr. Frankland seems

to have a strange partiality for analytical methods of this description, and (as was, I believe, pointed out by Roscoe) having had occasion to estimate the carbonic acid in the air, he did it by measuring the air before and after the action of caustic potash upon it, thereby employing a method affected by an experimental (or manipulatory) error which was about as large as the entire quantity of carbonic acid existing in the air which he examined. The average quantity of carbonic acid in atmospheric air amounts to about $\frac{1}{2500}$th of the volume of the air. Unless, therefore, the analyst can measure to less than $\frac{1}{2000}$th of the volume operated on, the two readings required for the estimation of the carbonic acid must be affected by an error of at least $\frac{1}{2500}$th of the volume of the air. When Dr. Frankland resorted to this doubtful method of determining the carbonic acid in the atmosphere, chemists were in possession of De Saussure's method, which is not affected by such an error.

I do not find that Dr. Frankland ever quarrelled with De Saussure, and cannot explain his rejection of the De Saussure process in favour of the one he used, unless, ndeed, he prefers processes of analysis where the experimental error is high and the result illusory.—I am, &c.,

J. Alfred Wanklyn.

SIMPLE METHOD FOR TESTING FOR POTASH.

To the Editor of the Chemical News.

Sir,—Mr. J. Steiner occupies the valuable space of the Chemical News (vol. xxxi., p. 231) by a reprint of a process so familiar to every chemical tyro as that of the estimation of potash by platinum chloride, with previous precipitation of sulphuric acid, &c., by baryta.

The note of Mr. J. Steiner contains no new suggestion—as he will find on reference to Fresenius (sixth English edition, pages 152 and 358).—I am, &c.,

W. T.

May 31, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 17, May 3, 1875.

Report on an Apparatus for Determining the Alcohol in Wines.—A. Malligand.—A very lengthy paper, incapable of useful abstraction.

Researches on the Phenomena Produced in Liquids by Electric Currents of High Tension.—M. G. Planté.—The author finds that the electrode which has the largest immersed surface gives its sign to the liquid of the voltameter. He has obtained results which seem to throw light on the origin of the fire-balls, or globular lightning, sometimes observed towards the end of an electric storm.

New Source of Magnetism Noticed by M. D. Tommasi.—M. Maumené.—The author considers that M. Tommasi has not correctly interpreted the phenomenon which he observed. Heat does not act so as to constitute a new source of magnetism. It produces a thermo-electric current, and this current develops the magnetism observed.

Inverted Sugar.—M. Maumené.—The author remarks that few bodies are so difficult to incinerate as normal sugar. Inverted sugar can be burnt far more easily. The determination of the ash in crude sugars is greatly facilitated by previously inverting the sample.

Decomposition of Neutral Fatty Bodies.—M. J. C. A. Bock.—The author's process is divisible into three stages—1. Rational acidification, having for its object to carbonise, rupture, and render permeable the albuminous envelopes of the fatty particles. 2. The fatty matter is then split up by means of acid diluted with water. The amount of acid required is about 5 per cent. 3. The fatty acid is bleached by boiling with permanganate.

New Apparatus for the Continuous Manufacture of Superphosphate.—M. P. Thibault.—This paper was accompanied with plans, which are essential to its intelligibility.

Action of Magnets upon Rarefied Gases Enclosed in Capillary Tubes, and Illuminated by an Induced Current.—M. J. Chautard.—The spectral modifications produced by the action of magnets upon the induction light traversing rarefied gases are subject to very complex laws The most striking result is an increase of resistance on the part of the induced current under the influence of the magnet. As long as the magnet is inactive the light circulates uniformly in the two tubes. It is suddenly arrested in the shorter and narrower tube at the moment when this is submitted to the action of the magnet. The effect may be produced with chlorine, iodine, sulphur, and selenium.

Solubility of Nitrate of Soda, and its Combination with Water.—M. A. Ditte.—Nitrate of soda, like nitrate of lithia, forms at low temperatures a compound with water. Nitrate of potash presents no similar phenomenon; its solution, saturated at zero, only contains 13·3 of the salt in 100 of water. If cooled to $-2°$, it becomes filled with crystals of the ordinary form of nitrate of potash. If we plunge into the same freezing mixture at $-13°$ or $-14°$ two tubes containing solutions saturated at zero, the one of nitrate of soda, and the other of nitrate of potash, the latter in a few moments becomes a solid mass, whilst the former remains liquid, in spite of agitation and of the presence of crystals of nitrate of soda in the tube. The melting-point of the hydrate, $NO_5NaO,14HO$, being below the temperature of the freezing mixture, it remains liquid.

Decolourising Property of Ozone.—M. A. Boillot.—One of the most striking properties of ozone is its bleaching power. The effects ascribed to chlorine are really due to ozone. Ozone employed directly acts as an oxidising agent, laying hold of the hydrogen of the substance with which it is in contact, whence results bleaching, if the body is coloured. On allowing chlorine to act upon any animal or vegetable matter, it decomposes a certain quantity of water and seizes its hydrogen, forming hydrochloric acid. The oxygen set free by this reaction is transformed into ozone, which in its turn lays hold of hydrogen present in organic matter.

Characters of Glycocoll.—M. R. Engel.—If boiled with a concentrated solution of potash or baryta glycocoll gives a blood-red colouration. If treated with sulphate of copper, and then with potash, it hinders the precipitation of the copper, giving a fine blue colouration. In the cold, and even in heat, it reduces mercurous nitrate. With perchloride of iron it gives an intense red, which disappears on the addition of an acid, and may be reproduced by cautiously neutralising the acid with ammonia. If a little glycocoll in solution is mixed with a drop of phenol and hypochlorite of soda is added, a fine blue colour appears in a few moments.

Bulletin de la Societe Chimique de Paris, No. 6, March 20, 1875.

Researches on Albumen.—M. P. Schützenberger.—The conclusion of the author's investigations on albumen.

Monobromated and Dibromated Camphor.—M. J. de Montgolfier.—Not adapted for abstraction.

Detection of Tarry Matter in the Ammonia of Commerce.—M. Kupfferschlæger.—The ammonia is gradnally poured into a test-tube containing dilute nitric

acid. If tarry matters are present, a "gooseberry red" colouration makes its appearance. [This test has been in use in dye-works, &c., in England, for at least seven years.]

Identity of the Bromated Derivatives of Tetrabromic Hydride of Ethylen, and those of Perbromide of Acetylen.—Edme Bourgoin.—Already noticed.

Mutual Displacement of Acetic and Formic Acids.—H. Lescœur.—The author has never succeeded in completely decomposing a formiate by an excess of acetic acid. The reaction is not more decided with the aid of heat than in the cold. Dilution of the acetic acid diminishes the amount of formiate decomposed.

Researches on the Selenites.—M. F. Nilson.—A memoir originally published, in the English language, in the *Transactions of the Royal Society of Sciences at Upsala*. The author considers the results of the late Dr. Muspratt inaccurate. The selenium employed was obtained from the lead-chambers of the Fahlun Work, in which it forms about 2 per cent of the mud. M. Nilson describes selenites of potash, rubidium, cæsium, ammonium, thallium, sodium, lithium, and silver.

Correspondence from St. Petersburg.—M. W. Louguinine.—The author briefly notices investigations by M. Schöne, on peroxide of hydrogen in the atmosphere; by M. O. Bogouch, on the formation of aldehyds; by M. N. Beketoff, on the separation of silver from nitrate of silver by the action of hydrogen; by W. Morkownikoff, on the oxidation of α-oxybutyric acid; by Beilstein, on the production of meta-dichloro-benzin by the action of nitrous acid and alcohol upon dichlor-aniline; by M. Boutlerow, on penta-methyl-e.hol; by M. Boradine, on the production of dithymol by the action of chloride of iron upon thymol, and on oxydinaphthalin obtained by distilling β-dinaphthal with anhydrous phosphoric acid.

Reimann's Farber Zeitung, No. 11, 1875.

This issue contains a notice of the manufacture of magenta, free from arsenic, by the reciprocal reaction of aniline, toluydin, and nitro-toluol, as carried on by the firms of Meister, Lucius, and Brüning, of Höchst, and the Aniline Manufacturing Company (late Dr. Jordan) of Berlin.

There are receipts for dyeing mixed doubles a light cinnamon; for a fast brown-red on wool; a fast brown-red on cotton-yarn; a chamois on cotton--wool; a pansy on gloves; and for printing a black design on a (madder) red ground.

No. 12, 1875.

This issue contains an article on patent law reform, in which the English patent laws are recommended for adoption in Germany.

Eosin.—If this colour is stirred up with water and sodium amalgam at a gentle heat the red liquid is decolourised, and colourless fluorescin produced. If this liquid is diluted with water, and a drop of permanganate added, it becomes green and opaque by reflected light, having been converted by oxidation into fluorescein.

Gris d'Aniline or Nigrosin in Silk Dyeing.—With this colour the silk dyers produce all their greys, modes, dark blues, plum-colour, and Russian green at prices very little exceeding the wood colours. The same colour-beck can be used for days. The gris d'aniline soluble in spirit is preferable to that soluble in water, as the latter is apt to come up flat in the darker shades. The operation is performed at a boil, with soap and sulphuric acid. With the addition of orchil and young fustic are produced all conceivable shades of grey, mode, and olive green. For dark greens turmeric is added, or a combination of gris d'aniline, aniline blue, and turmeric is used. The green shades may be brightened by topping with picric acid in a fresh beck. Dark blue is obtained with gris d'aniline and aniline blue. In dissolving the colour, proceed as for other aniline colours soluble in spirit, and the solution is filtered for use. To 1 kilo. of silk are taken half a gallon of strong soap-lye (*cuite*); the beck is made up with water, 65 grms. of sulphuric acid are added, and the whole heated to 60°, and afterwards raised to a boil, without which the shades will be uneven.

There is also a method for stripping mixed (half wool) garments of an alkaline blue, and for turning them to a claret.

The new indigo vat (Schützenberger's and de Lalande's hydrosulphite process) is producing in practice remarkably good results, and promises at an early date entirely to supersede all other vats in woollen dyeing.

No. 13, 1875.

This issue contains remarks on the new indigo vat; receipts for printing a green on woollen yarns and tissues; for a black on the same material; a black on felt hats; a fast light indigo blue without indigo; and for bleaching linen and cotton.

To Prevent Boiler Incrustations.—Galls, 1 part; glue, ½ part; soda, ½ part. Another authority proposes to boil 30 kilos. soda, 12 kilos. potash, and 1 kilo. catechu in 20 gallons of water, and pour the decoction into the boiler.

Bang proposes to prepare soluble prussian blue, and dye wool and silk with it at a boil.

Thiré and Duport dissolve aniline colours in alcohol, mix the solution with benzol, and dye with it. A similar method can be pursued with dye-woods and astringents.

Methyl Green on Wool (50 kilos).—One-half kilo. of borax on soluble glass, 1 kilo. methyl green. Work for thirty to forty minutes at 65° R., rinse, and treat at 40° R. with 5 kilos. alum, 250 grms. bichloride of tin, and 250 grms. acetic acid. To the second dye-bath 250 to 400 grms. picric acid may be added.

Delobel proposes as a mordant for the aniline colours a mixture of sulphuric acid, turpentine, alum, and borax.

Chevreuse obtains a brown dye by beheading cockchafers!

Les Mondes, Revue Hebdomadaire des Sciences.
No. 12, March 25, and No. 13, April 1, 1875.

These issues contain no chemical matter.

MISCELLANEOUS.

Obituary.—We much regret to hear of the untimely decease, at the early age of 27, of Mr. Samuel William Moore, L.R.C.P., F.C.S., &c., Demonstrator of Physiological Chemistry in St. George's Hospital Medical School. Mr. Moore had established for himself a reputation as a promising worker in the fields constituting the borderland between chemistry and physiology, his attainments in this branch having three years ago secured his election to the important post held by him in St. George's Hospital; his "Notes of Demonstrations" on this subject, subsequently published in our columns, constitute a valuable contribution to chemical and medical literature. Mr. Moore's first scientific paper on "Brain Crystals" was published in the Chemical News when he was little more than 18 years of age; and at the time of his last illness he was engaged on a laborious series of researches on the effects of tobacco, the British Medical Association being on the point of furnishing a considerable grant in furtherance of this object. Through the long-continued illness and premature removal of this talented student of nature, a young widow and two infant children are left wholly unprovided for and almost wholly destitute. We understand that the friends of the deceased contemplate making an appeal to the liberality of the medical profession and the scientific public with a view to raising a fund for the benefit of his family. The following gentlemen have kindly consented to form a committee for this purpose:—Dr. Barclay, St. George's Hospital; Dr. Bot

20, Kennington Park Road, S.; J. Croft, Esq., St. Thomas's Hospital; W. M. Ord, Esq., St. Thomas's Hospital; G. D. Pollock, Esq., St. George's Hospital; Dr. Wadham, Dean of the Medical School, St. George's Hospital, W.; Dr. C. R. A. Wright, St. Mary's Hospital, W. (Hon. Treasurer). Subscriptions in aid of this object will be gladly received by Dr. Wadham at the above address; we have much pleasure in cordially recommending the case to the benevolence of our readers.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of soda and potash. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Hermann Gruneberg and Julius Vorster, both of Kalk, Germany.) July 28, 1874.—No. 2639. This invention relates to the manufacture of soda and potash, and consists in causing superheated steam to pass over a mixture of common salt and alumina, or hydrated alumina if soda is to be produced, and over a mixture of chloride of potassium and alumina, or hydrated alumina if potash is to be produced, the same being maintained at a high temperature.

Improvements in the treatment of saccharine solutions. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Léon Maron, Paris.) August 5, 1874.—No. 2713. The essential feature of this invention consists in raising the saccharine solutions to a boiling temperature, and then adding thereto or bringing the same in admixture in another vessel with a solution of lime or baryta, and then adding an alkali, either soda, potash, or ammonia, the same being by preference free from carbonates.

Improvements in separating the hair or wool from fresh or dry skins, and preserving the hair or wool in its natural state as if cut from a live animal. Joseph Lambert De Montoison, Thurloe Square, South Kensington, London. August 8, 1874.—No. 2746. The inventor separates the hair or wool from skins by softening the fresh or dried skins with warm water, and then covering the flesh side of the skin with a pentasulphite composed of hydrosulphite of soda, sulphate of arsenic green potash, hydrosulphate of barium, and hydrate of fresh lime, which penetrates the thickest of skins almost instantly.

A new or improved fuel for metallurgical and other purposes. George Gordon de Luna Byron, Chancery Lane, Middlesex. (A communication from C. Edwards Lester, New York, U.S.A.) August 8, 1874.—No. 2751. Desulphurising and dephosphorising coal or its refuse when placed in union with any other substance or substances. The production of solid hydrocarbon by the union of hydrogenous and carbonaceous substances, when said substances are treated chemically and mechanically.

An improved tonic preparation of liquid extract of beef or meat. Edward Theodore Digby, Christopher Gandy, William Foyl, jun., and Edward Barry Allinson James, constituting the firm of Digby, Gandy, and Co., Liverpool, Lancaster. (Partly a communication from Joseph James Livesey, Montreal, Canada.) August 13, 1874.—No. 2799. The features of novelty which constitute this invention consist of an unproved tonic preparation of liquid extract of beef or meat, the ingredients of which are wine or other alcoholic liquor, glycerin, and extract of beef or meat (which may be prepared in manner similar to the Liebig system), syrup, quinine, or tincture of Peruvian bark, flavouring consisting of nutmegs, cloves, cinnamon, or other suitable spices.

Improvements in the method of and apparatus for obtaining ammonia from waste products and other matters. Henry Michael, patent agent, Fleet Street, London. (A communication from Joseph Alfred Ferdinand Lair, Boulevart St. Martin, Paris.) August 13, 1874.—No. 2802. The invention is especially applicable for treating waste products, the refuse heat and deposits being utilised, and offensive smells removed; pumps, heaters, and separating vessels are combined with the distilling column into which the liquid whence the ammonia to be extracted is driven, after passing through tubular heaters heated by the freed liquid from the distilling column. Steam and lime-white are introduced into the distilling column, the liquid from which passes into a separator fitted with an internal tube, at the bottom of which the deposits are left; the ammoniacal vapours pass into the sulphuric acid vessels through tubes heated by steam-pipes. To remove offensive vapours, the gases are carried under the generator-furnace. The pumps are regulated so as feed the liquid and lime-white in proper portions.

MEETINGS FOR THE WEEK.

Monday, June 7th.—Royal Institution, 2, (General Monthly Meeting).
Tuesday, 8th.—Anthropological Institute, 8.
—— Photographic, 8.
Wednesday, 9th.—Geological, 8.
Thursday, 10th.—Royal, 8.30.
Friday, 11th.—Astronomical, 8.
—— Quekett Club, 8.
—— Anthropological, 7.30.
Saturday, 12th.—Physical. "On the Electrical Conductivity of Graphite," by Mr. Wildman Whitehouse. "On the Time Required for the Double Decomposition of Salts," by the President.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By Thomas Richardson and Henry Watts. Second Edition, illustrated with numerous Wood Engravings.

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THE CHEMICAL NEWS.

VOL. XXXI. No. 811.

ON THE DETERMINATION OF CARBONIC ACID WITH SCHEIBLER'S APPARATUS.

By R. WARINGTON.

WISHING to ascertain whether a speedy and accurate analysis of tartar might not be accomplished by neutralising the tartar, evaporating to dryness, igniting the residue, and determining the quantity of carbonic acid in the ash, I naturally sought, in the first place, for some good and speedy method of determining carbonic acid. Scheibler's volumetric method being largely used, and well recommended, at once suggested itself as suitable for my purpose. Mr. W. E. Halse, on learning my wishes, very kindly placed a Scheibler's apparatus at my disposal. The experience gained while using the apparatus has, I think, brought to light a rather considerable error which is involved in the ordinary practice with this instrument; this point I propose now to consider, reserving the results obtained with regard to tartar for a paper to be read shortly at the Chemical Society.

As I write for those using the apparatus, a description of the ordinary process will be unnecessary. In Scheibler's pamphlet* accompanying the apparatus, instructions are first given for the determination of carbonates in bone charcoal, and afterwards the general determination of carbonic acid by means of the apparatus is described: we will consider the latter instructions first.

The carbonate to be analysed is placed in the generating bottle, and acted on by 10 c.c. of hydrochloric acid, sp. gr. 1·12, contained in a tube which is overturned after the bottle is closed; the gas evolved is then measured over water in the graduated tube of the apparatus. It is evident that the whole of the carbonic acid will not be evolved in the form of gas, but that some part of it will be retained in solution by the fluid in the generating bottle. Scheibler therefore directs that a correction of +0·8 measure is to be made to the volume of gas obtained. As the scale which Scheibler describes in his pamphlet is a scale of 25 measures, which is stated to be equal to 100 c.c., it is evident that the correction made is 3·2 c.c., and the evidence afforded by various parts of the pamphlet is overwhelming, that this is, in fact, the correction which he directs. Fresenius, however, states (fourth English edition, page 713) in his description of the process, "Scheibler has determined the small amount of carbonic acid which remains dissolved in the 10 c.c. hydrochloric acid at the mean temperature, and he directs to add 0·8 c.c. to the volume of the carbonic acid read off." This mistake of substituting 0·8 c.c. for 0·8 measure is again made by Mr. E. Nicholson (CHEMICAL NEWS, vol. xxix., p. 245), he says "Dr. Scheibler sets it down as 0·8 c.c. for 10 c.c. of acid, sp. gr. 1·12." Mr. Nicholson, however, goes on to say that he himself employs as a correction 1 c.c. when using only 5 c.c. of acid, and that this correction is a little too low; Mr. Nicholson's practice is thus not very far from Scheibler's actual direction.

Now this direction of Scheibler to employ a fixed correction for the quantity of carbonic acid retained by the fluid is, I believe, an entire mistake; the quantity thus retained being really proportional to the quantity of gas evolved, as can be shown both from theoretical considerations and by experiment.

The contents of the generating bottle are to be shaken by rolling the liquid round the sides, so long as the column of water continues to fall in the measuring tube. Now supposing only a little carbonic acid has been evolved, the fluid is thus shaken with air containing very little of this gas, and the tension of the carbonic acid in the atmosphere being very small, the amount permanently retained by the fluid is small also. If, however, much carbonic acid has been set free, the atmosphere in the bottle is rich in this gas, its tension is much greater than in the former case, and the fluid retains a much larger quantity in solution. If, therefore, a fixed correction of 3·2 c.c. is employed in every experiment, the result will be much too high when a small quantity of carbonic acid is produced, and much too low when a large quantity has been evolved. It was, in fact, by trying the apparatus with large and small quantities of pure carbonates that I was led to perceive the error in question.

Scheibler is not altogether unconscious of the source of error involved in his fixed correction of +3·2 c.c., for he directs (p. 24) that the quantity of the sample taken should be such that the volume of gas set free should fall between 15 and 25 measures (60—100 c.c.), as with a smaller volume of gas the correction of 0·8 measure is no longer constant. This important statement, which greatly diminishes the value of the process, is omitted in Fresenius, who, after describing the process as of general application, merely says "the quantity [of bone-black] taken must be such that the amount of carbonic acid obtained may not be too small; about 3 grms. of the dried substance may be considered as the correct quantity." Nicholson also gives no hint of the limitation of his correction to certain volumes of gas. It is quite evident, however, that if what has been advanced is true, the corrections both of Scheibler and Nicholson can only be strictly accurate for *one volume* of gas, and cannot be extended with exactness to even a limited range.

The constant correction being shown to be erroneous, I next endeavoured, by means of test experiments with pure carbonates, to ascertain the true corrections for each volume of gas obtained. The first series of trials was made with pure anhydrous carbonate of sodium, and as it was intended in the experiments with tartar to remove the ash into the generating bottle by means of 5 c.c. of water, the carbonate of sodium was in this case also dissolved in 5 c.c. of water before being acted on by the hydrochloric acid. The total quantity of fluid in the generating bottle was thus 15 c.c., instead of the 10 c.c. supposed by Scheibler. The generating bottle was shaken in every case three minutes before reading. The results obtained were as follows. The carbonic acid is throughout expressed as cubic centimetres at 16°, and 760 m.m. pressure, saturated with water:—

Carbonate of Sodium taken (Gram).	Number of Experiments.	Carbonic Acid Evolved (Mean).	Carbonic Acid present in Carbonate of Sodium.*	Correction required in Experiment.	Correction at 7 per Cent.
0·05	1	10·67	11·30	0·63	0·75
0·10	5	21·25	22·61	1·36	1·49
0·15	1	31·58	33·91	2·33	2·21
0·20	5	42·28	45·22	2·94	2·96
0·25	1	52·52	56·52	4·00	3·68
0·30	5	63·32	67·82	4·50	4·43
0·35	2	73·58	79·13	5·55	5·15
0·40	5	84·30	90·43	6·13	5·90
0·45	2	95·02	101·74	6·72	6·65
0·50	6	105·71	113·04	7·33	7·40

* The volume of the carbonic acid in 1 grm. of carbonate of sodium at 16°, and 760 m.m., saturated with water, is here taken as 226·08 c.c., this being the relation of weight to volume in Scheibler's concluding tables, which I wished to make use of; my own calculation would make it 226·97 c.c.

The column showing the amount by which the measured gas fell short of the theoretical quantity present, proves at once that no fixed correction is possible

* I quote throughout from an edition dated 1871.

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If we assume that with 15 c.c. of fluid in the bottle Scheibler's correction would be increased by one half, it will thus become 4·8 c.c., which will be the proper correction for some volume of gas between 60 and 70 c.c., but will be the proper correction for no other volume.

The last column in the table shows that we may assume with very little error that in the case of these experiments the correction needed is 7 per cent of the gas measured. Theoretically the correction should be a diminishing proportion with increasing quantities of gas, as the evolution of twice as much gas in one experiment as in another cannot quite double the tension of the carbonic acid in the generating bottle. It is quite possible, however, that other causes modify the result; thus the more carbonic acid is evolved, the more is the hydrochloric acid neutralised, and the liquid containing less hydrochloric acid in solution may be able to absorb more carbonic acid, and thus the diminishing increase of pressure may be counterbalanced by a corresponding rise in the solvent power of the liquid. The varying quantities of chloride of sodium present, and the heat of combination, may also affect the result.

The next series of experiments was made with Iceland spar powdered and dried; 10 c.c. of hydrochloric acid sp. gr. 1·12 were employed, and no water. The conditions were in these experiments precisely those supposed by Scheibler. Shaking was continued for two minutes in every case. The volumes of gas are reduced to the same pressure and temperature as before.

Carbonate of Calcium taken (Grm).	Carbonic Acid Evolved. First Experiment.	Second Experiment.	Mean.	Carbonic Acid present in Carbonate of Calcium.	Correction required in Experiment.	Percentage Correction.
0·05	11·28	11·14	11·21	11·98	0·77	6·9
0·10	22·50	22·48	22·49	23·96	1·47	6·5
0·20	45·20	45·02	45·11	47·93	2·82	6·3
0·30	67·87	67·89	67·88	71·89	4·01	5·9
0·40	90·91	90·71	90·81	95·86	5·05	5·6
0·50	113·60	113·23	113·42	119·82	6·40	5·6

Scheibler's correction of 3·2 c.c. is by this table the true correction when about 50 c.c. of gas are evolved, but in no other case. We have here a smaller percentage correction than in the previous series, the quantity of fluid in the generating bottle being less; the percentage correction also diminishes somewhat with the increase of the gas evolved, which we have already seen was theoretically to be expected. The results with Iceland spar were more accordant than those with carbonate of sodium.

Two further experiments were made with carbonate of calcium, 5 c.c. of water being added as in the previous experiments with sodium carbonate. 0·10 grm. of Iceland spar gave 22·22 c.c. of gas, reduced to 16°, and 760 m.m.; the correction required was therefore 1·74 c.c., or 7·83 per cent. With 0·40 grm. of spar, 89·19 c.c. of gas were obtained, requiring a correction of 6·67 c.c., or 7·47 per cent.

We now turn to the first part of Scheibler's pamphlet, in which he gives instructions for the determination of carbonate of calcium in bone charcoal. Here the volume of gas found is not corrected by the addition of 0·8 measure, but 1·7 grms. of charcoal having been taken for the determination, the percentage of carbonate of calcium is at once found by referring to Table I., in which to every measure of gas found is assigned its value in percentage of carbonate of calcium. The accuracy of this table can be easily examined by means of the test experiments with calcium carbonate just quoted; we have only to imagine that in each of these experiments 1·7 grms. of charcoal was taken, containing the quantities of carbonate of calcium actually operated on, and compare the percentage of carbonate of calcium present on this assumption with the percentage deduced in Scheibler's table from the volume of the gas.

Carbonate of Calcium taken (Grm).	Percentage if 1·7 Grms. Present.	Percentage by Scheibler's Table I.
0·05	2·94	2·71
0·10	5·88	5·64
0·20	11·76	11·28
0·30	17·65	16·86
0·40	23·53	22·49

It is clear from these figures that the percentages of carbonate of calcium deduced from Scheibler's Table I. are too low, and that the error is somewhat serious. I confess I do not understand how Table I. has been calculated, especially how in any part of the scale a measure of gas can have a smaller value than the amount of carbonic acid it contains; this is, however, actually the case in a part of Scheibler's table.

Scheibler's apparatus is one of great practical value, as very speedy results of fair accuracy can be obtained by its use. The mode of calculating the results described by Scheibler must, however, be abandoned, so far as the use of a fixed correction for the retention of gas in the fluid, and the employment of Table I. is concerned. By substituting a correction proportional to the volume of gas obtained, and reducing the volume of gas into terms of the carbonate sought by means of Scheibler's Tables III.—VI., the errors hitherto made will be avoided. I do not at all pretend that the proportional corrections here given as the result of my own experiments will be found to hold good at all temperatures, they are probably strictly true only for the temperature of the experiment.* A far more complete series of observations is required.

There are one or two points connected with the use of the apparatus which I will in conclusion briefly mention. Any rise of temperature during the experiment entails a notable error, as the final reading is increased by the expansion of the whole volume of gas in the apparatus. A small rise in temperature is sure to take place if the operator stands before the instrument for two or three minutes while shaking the generating bottle. This may be avoided by placing a narrow glazed screen between the instrument and the operator. The generating bottle should also be wrapped in paper during the agitation. Bone charcoal, and many other substances in which carbonic acid has to be determined, contain small quantities of sulphides; to prevent sulphuretted hydrogen being evolved a small quantity of mercuric chloride may be dissolved in the hydrochloric acid used.

ACTION OF CHLORINE ON PYROGALLOL.†

By JOHN STENHOUSE, LL.D., F.R.S., and CHAS. E. GROVES.

The authors, after noticing the unsatisfactory results which they obtained by acting on pyrogallol in aqueous solution, proceed to describe the phenomena which take place when a current of chlorine is passed through a mixture of pyrogallol with twice its weight of glacial acetic acid.

At first, the liquid, which should be kept cool, assumes a dark, inky, purple colour, and occasionally deposits crystals of pyrogallol, thrown down by the hydrochloric acid produced in the reaction. As the action proceeds, however, these dissolve, and at last, when saturated with chlorine, the solution becomes of a pale orange red. If it be now heated to 70° C. for a short time, carbonic anhydride and hydrochloric acid are given off, and on cooling brilliant crystals of *mairogallol*‡ are deposited.

Mairogallol, $C_{18}H_7Cl_{11}O_{10}$, forms hard colourless six-sided prisms, which are insoluble in water, but very

* The temperatures during the test experiments varied from 15° to 18° C.

† Abstract of a Paper read before the Chemical Society.

‡ From μαιρω, obs. to glitter.

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soluble in ether and moderately so in boiling glacial acetic acid. It dissolves in hot concentrated nitric acid, and crystallises out again unchanged on cooling.

Leukogallol, $C_{18}H_6Cl_{12}O_{12}+20H_2$, is prepared from pyrogallol by saturating the acetic acid mixture with chlorine in the cold in the manner above described; but, instead of heating the solution, about one-fourth of its bulk of concentrated hydrochloric acid is added. Carbonic anhydride and hydrochloric acid are evolved, and on standing the whole solidifies to a mass of minute crystals of the new substance. These are first partially purified by submitting them to strong pressure, to remove as much of the acetic acid as possible, and afterwards washing them with benzene. On dissolving the substance in the smallest quantity of dry ether, adding about one-third of its bulk of benzene, and then evaporating the ether in a current of dry air, crystalline crusts are deposited on the sides of the flask, which, when washed with a mixture of benzene and ether and re-crystallised two or three times, are ultimately obtained pure and colourless. This compound is readily soluble in water, but only moderately so in ether; nearly insoluble in benzene. When heated with nitric acid it is decomposed, with evolution of nitrous fumes and formation of chloropicrin, but no oxalic acid. At 104° it melts, but is at the same time decomposed, water and hydrochloric acid being given off and new products formed, one of which is readily soluble in hot benzene and crystallises out again on cooling in tufts of colourless needles. Leukogallol differs remarkably from mairogallol, by its great instability.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from page 243).

ATTENTION was directed to more sensitive transferrers of oxygen than baryta, and in the first place to chloride of copper. Its property, on exposure to the air to pass into oxychlorides of various composition, lies at the root of the manufacture of a well-known pigment, Brunswick green. In 1855, Vogel proposed the action of hydrochloric acid upon oxychlorides of copper as a source of chlorine.† Mallet‡ examined these bodies more closely, and in 1867 and 1868 proposed a method for the industrial preparation of chlorine and oxygen. He found that cuprous chloride is converted into oxychloride by a current of steam at from 100° to 200° C., which, in contact with hydrochloric acid, is immediately resolved into cupric chloride and free chlorine, but which, if heated to 400°, gives off all its oxygen. One kilo. of cuprous chloride yields 28 to 30 litres of oxygen. In experiments on the large scale, 100 kilos. of cuprous chloride yielded either 3 to 3½ cubic metres of oxygen or 6 to 7 cubic metres of chlorine. As four or five such operations can be conducted daily, 200 to 300 kilos. of cuprous chloride could be made to yield daily 15 to 18 cubic metres of oxygen. The requisite apparatus consists of rotatory cast-iron retorts lined with clay, which contain the cuprous chloride mixed with one-third sand or kaolin to diminish its fusibility. This process was carried out in Cologne in 1871.‖ A company established at Paris for the utilisation of the process flourished for a short time only,§ probably because it was superseded by an analogous process.

We refer to the method which has been developed since 1867* by the suggestive inventor, Tessié du Motay. Its transferrer of oxygen is the black oxide of manganese, and it is based upon the following reactions:—Hydrate of soda, according to Mitscherlich, if heated to dull redness in contact with air and black oxide of manganese, yields manganate of soda and water—

$$4NaOH+2MnO_2+2O=2Na_2MnO_4+2H_2O.$$

Manganate of soda at the same temperature in a current of dry superheated steam is resolved again into hydrate of soda, sesquioxide of manganese, and free oxygen—

$$2Na_2MnO_4+2H_2O=4NaOH+Mn_2O_3+3O.$$

The only condition, then, is to free the superheated air previously from carbonic acid, in order to obtain a mixture which shall be perpetually efficient. This method has been found satisfactory on re-eated scrutiny, and has been applied on the large scale at Comines (near Lille), at Pantin (near Paris), at New York, Brussels, and Vienna. Bothe† reports that a melting of 60 parts of dry carbonate of soda with 40 parts of peroxide of manganese at 95 per cent yielded, according to analysis 74·62 of manganate of soda, and that 40 kilos. of this substance, which, according to theory, should yield 2036 cubic decimetres of oxygen, actually produced 1800, or 90 per cent of the calculated yield. He recommended the process as easy of execution. The most complete description has been given by Pourcel‡. According to him, Tessié du Motay employs for retorts cast-iron ellipsoids, which lie horizontally side by side and are divided by a grate into two unequal portions parallel with their axis. Upon the grate are spread in each retort 350 kilos. of manganate of soda, or the corresponding reduced mixture of soda and manganese, in such a manner that its thickness amounts to 0·6 of a metre, and the empty space above and below the mass is as small as possible. In Comines, where five such retorts are in action, the daily production amounted to 140 cubic metres of oxygen, with an expenditure of 450 kilos. of coal for heating the retorts and 150 kilos. for the steam-engine.

(To be continued.)

ON A NEW WAY OF OBSERVING ABSORPTION SPECTRA.

By Dr. T. L. PHIPSON.

I THOUGHT it would be interesting to ascertain what effect upon the absorption spectrum of any given substance would be obtained if this spectrum was viewed through a thin layer of the substance itself. I therefore disposed my spectroscope with the double slit, so that one slit gave the spectrum of the substance to be examined and the other that of the solar light, and both these spectra were viewed at the same time through a thin layer of the substance to be examined. In this way I found that the slit giving the spectrum of the solar light only, was now producing the absorption bands of the substance placed before the prism, and that the absorption bands in the other spectrum were augmented in intensity as if a much thicker column of fluid had been used to produce its spectrum. It is therefore quite possible to study the absorption bands in the spectrum of a liquid when the latter is placed in a thin layer between the eye and the prism, the slit of the spectroscope receiving only ordinary daylight; and the action of a thin layer of the substance yielding the spectrum upon the latter, when this thin layer is placed before the prism, consists in increasing its intensity, just as if the thin layer had been placed between the substance examined and the slit of the instrument. The experiments were made with dilute solution of acid permanganate of potash.

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."
† Vogel, Wagner, *Jahresberichte*, 1861, 177.
‡ Mallet, *Comptes Rendus*, lxiv., 286, and lxvi., 349.
‖ Phillips, "Der Sauerstoff" (Berlin, 1871), 22.
§ Wagner, *Jahresberichte*, 1867, 215.

* Tessie du Motay, *Institut*, 1868, 48.
† Bothe, *Zeitschr. d. Vereins Deutsch. Ing.*, 1867, 334.
‡ Pourcel, "Mémoires de la Société des Ingénieurs Civils," P 1873.

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This action of a thin layer of any substance upon its own spectrum may prove useful in many cases, either to verify this spectrum, or to increase its intensity, &c.

Laboratory of Analytical Chemistry,
Putney, S.W.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 3, 1875.

Professor ABEL, F.R.S., President, in the Chair.

AFTER the minutes of the previous meeting had been read and confirmed, and the donations announced, Messrs. P. Melmore, R. E. H. Goffin, C. G. Cresswell, and A. Senier, were formally admitted Fellows of the Society. The names read for the first time were those of Messrs. A. W. Gerrard, J. Brett Guyer, E. Gee, and A. N. Gow, Messrs. Falkland Mackinnon, Charles Thomas Blanshard, B.A., George Crampton, John Cope Butterfield, Joseph Wilson Iwan, Alexander Wynter Blyth, Robert Stetton, Thomas Purdie, jun., and the Rev. W. J. J. Welch, M.A., were elected Fellows of the Society after their names had been read the third time.

The first paper, by Mr. J. T. COLEMAN, was on "*The Effects of Pressure and Cold upon the Gaseous Products of the Distillation of Carbonaceous Shales.*" The author finds that if the gas which is produced in such large quantities in the preparation of oils by the distillation of shales is submitted to a temperature of 0° F., at a pressure of 140 lbs. to the square inch, a quantity of volatile hydrocarbons having a density of about 0·680 is obtained suitable to be used for air-gas purposes, or for increasing the illuminating power of poor coal gas. The amount of liquid condensed is about one gallon per 1000 cubic feet of gas. The latter, after the removal of these hydrocarbons, burns with a blue flame resembling that of a Bunsen's burner.

The PRESIDENT having thanked the author for this interesting communication, a paper by Dr. C. BROWN "*On the Agricultural Chemistry of the Tea Plantations of India,*" was read. This paper contains a large number of analytical results connected with the cultivation of the three varieties of the tea plant grown in India. In one instance it was found that in the portion of the tea garden treated with Dr. C. Brown's fertiliser, the yield of tea per acre was 494 lbs., and in the unmanured portion it was only 397 lbs. Analysis of the ash of the two specimens of tea yielded results which were almost identical.

The PRESIDENT, in thanking Dr. Brown for his important contribution to the agriculture of the tea plant, said it would scarcely be possible to do justice to it without studying it in detail.

Mr. WAY was much struck by the interesting fact which the table of the ash constituents showed, that there was a large amount of soda uncombined with chlorine. In his own somewhat extended experience he had observed that the sodium, in most cases, was chiefly present as sodium chloride.

Mr. WARINGTON remarked that the diminution in potash and phosphoric acid, and the increase in lime, which Dr. Brown found in the old leaves as compared with the young buds, also occurred in the older leaves of forest trees. It had been suggested that the proportion of potash to lime in the ash of tea would determine whether it were made from young or old leaves, but by adulteration, old tea leaves with the buds of other plants, the natural proportion of lime and potash would be destroyed. Dr. Brown had apparently selected a manure for the tea plant from considerations based on the composition of the ash. The composition of a plant was a very unsafe guide to the selection of an economical manure. Thus the turnip was rich in potash and poor in phosphoric acid, yet the latter substance was by much the more efficient manure. Clover, again, was a highly nitrogenous crop, while wheat contained far less nitrogen; yet nitrogenous manures had scarcely any effect on clover, but greatly increased the growth of wheat. The fact was that plants assimilated different portions of their food with different facility, and required most aid from manure in respect of those ingredients which they had most difficulty in acquiring. Actual experiment with a series of manures was the only means of ascertaining the most economical manure for a given crop and soil.

Dr. THUDICHUM remarked that the table suggested a very interesting point. We knew that potash was very necessary for plant growth, and it was remarkable that as the leaf grows old it loses its potash. It would appear from this that after the potash had served to build up the leaf, as it were, it was absorbed again into the system, its place being taken by lime and magnesia. In certain pathological diseases the potash in the cell structure is withdrawn and replaced by lime. It would seem, therefore, and this was a point of great importance, that potash was essential both to animal and to vegetable life.

He did not quite agree with the last speaker as to the effect of manures. In the case referred to it was not the phosphoric acid, but the sulphuric acid which was accidentally present, that gave the manure its peculiar action.

Professor MASKELYNE then gave a short account of Mr. J. A. Phillips's paper "*On the Structure and Composition of Certain Pseudomorphic Crystals having the form of Orthoclase.*" These remarkable crystals, which occur at Huel Coates, in Cornwall, are felspar crystals in which the potash has been removed and its place occupied by oxide of tin and other minerals. The author has procured thin sections of these crystals and submitted them to microscopical examination. He describes their appearance as that of a mass of interlaced mica-like plates of a silvery white colour interspersed with quartz crystals and crystals of tin oxide, and in some instances blue tourmaline (indicolite). The paper contains analyses of two specimens of these pseudomorphs of very different composition.

The PRESIDENT said the Fellows were much indebted to the author and also to Professor Maskelyne for the lucid comments which he had combined with the summary of the paper.

Dr. WRIGHT then read two papers by himself, and Mr. G. H. BECKETT, the first of which was entitled "*Notes on the Sulphates of Narceine and other Narceine Derivatives.*"

After referring to the pertinacity with which narceine hydrochloride retains traces of hydrochloric acid, and the readiness with which the former is decomposed by water, the authors say that in no case could they get any definite narceine sulphate more basic than the "bisulphate," which is prepared by crystallising narceine from dilute sulphuric acid two or three times. It has the composition $C_{23}H_{29}NO_9.H_2SO_4.10H_2O$, but breaks up in presence of water into more basic salts of indefinite composition. Unlike the hydrochloride, narceine sulphate is *completely* decomposed by sodium carbonate, affording a means of obtaining pure narceine. The action of nascent hydrogen on narceine removes the oxygen and gives rise to an uncrystallisable base. When narceine is heated with acetic anhydride it is partly dehydrated, and with excess of ethyl iodide it yields a varnish like non-crystalline compound $C_{23}H_{29}NO_9.C_2H_5I$.

In the second paper "*On the Action of Organic Acids and their Anhydrides on the Natural Alkaloids. Part V.*," the authors treat of the action of succinic acid, camphoric acid, and oxalic acid, on codeine and on morphine, and of tartaric acid on codeine. With succinic acid the action is not similar to that which takes place with the mo-

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basic acids, but a new class of compounds is formed analagous to the ethylene-succinic acid of Lourenço. The action of oxalic acid on the alkaloids converts them into a mixture of polymerides from which, in one case, dicodeine and tricodeine were isolated, and in the other dimorphine, trimorphine, and tetramorphine.

The President thanked the authors, in the name of the Fellows, for their valuable papers. After which a communication, entitled "*Action of Chlorine on Pyrogallol*," by Dr. J. Stenhouse and Mr. C. E. Groves, was read by the latter. An abstract of this appears in another part of our Journal. At its conclusion Mr. Lewis gave an account of three forms in which mairogallol crystallises.

The President having thanked the authors for their interesting communication, Mr. W. H. Perkin read a paper "*On Nitro-alizarin*." He finds that the action of nitric acid on diacetyl-alizarin produces nitro-alizarin $C_{14}H_7(NO_2)O_4$, a very definite and stable body crystallising in orange yellow needles, and dissolving in caustic alkalis with a beautiful blue colour. Reducing agents convert this into amido-alizarin $C_{14}H_7(H_2N)O_4$, which crystallises from alcobol in dark chocolate coloured needles with a greenish metallic lustre. The solutions of this substance are crimson red, and its alkaline derivatives are of a similar colour.

Nitro-alizarin produces with alumina mordants an orange red colour similar to "aurin," and with iron mordants a reddish purple, whilst amido-alizarin gives a purple with alumina mordants, and a bluish violet or steel colour with iron. Both these derivatives dye unmordanted silk; nitro-alizarin a clear golden colour, and amido-alizarin a purple red. The author also gave an account of monacetyl-alizarin $C_{14}H_7(C_2H_3O)O_4$. It crystallises in golden scales, and like the diacetyl derivative, is readily decomposed by alkalis.

The President thanked the author in the name, of the Fellows for his valuable and interesting paper, and Mr. R. Williamson then read a communication "*On some Metallic Derivatives of Coumarin*." After noticing the silver compound $C_9H_6O_2.Ag_2O$ obtained by Mr. Perkin, the author proceeded to give a description of the various derivatives he had obtained. The sodium compound $C_9H_6O_2.2NaHO$ forms a yellow gummy product which does not crystallise. When heated to 150° C. it loses water, and then no longer yields coumarin when treated with an acid, but an amorphous brown substance. The potassium compound $C_9H_6O_2.2KHO$ is very similar. The barium compound is not crystallisable. All these are prepared directly from coumarin and an aqueous solution of the base. The lead compound, $C_9H_6O_2.2PbO$, is obtained as a bright yellow precipitate on adding plumbic nitrate or acetate to a solution of the sodium compound.

The last paper was on "*The Action of Dilute Mineral Acids on Bleaching Powder*," by Mr. F. Kopfer. The author, after noticing the conflicting statements as to the nature of this important compound, gives details of the experiments he made by carefully distilling an aqueous solution of carefully prepared chloride of lime with various acids (acetic, hydrochloric, and nitric) in the proportion sufficient to liberate only the hypochlorous acid, assuming the formula—

$$Ca\begin{cases}Cl\\OCl\end{cases}$$

proposed by Dr. Odling to be the correct one. In all cases he found that pure hypochlorous acid was obtained free from chlorine. It would seem therefore that the view of the constitution of this compound originally proposed by Gay-Lussac, or that of Odling, is the correct one.

The next meeting, the last of the session, will take place on Thursday, June 17, when the following papers will be read:—

(1) "On Nitrosyl Bromide and on Sulphur Bromide," by Mr. M. M. P. Muir; (2) "Notes on the Chemistry of Tartaric and Citric Acid," by Mr. R. Warington; (3) "On the Action of Nitric Acid on Copper, Mercury, &c., Especially in the Presence of Metallic Nitrates," by Mr. J. J. Ackworth; (4) "Decomposition of Water by the Joint Action of Aluminium and Aluminium Iodide, Bromide, or Chloride: Including Instances of Reverse Action," by Dr. Gladstone and Mr. A. Tribe; (5) "On Achrematite: A New Molybdo-Arseniate of lead;" (6) New Reactions of Tungsten," by Professor Mallet; (7) "On the Action of Chlorine on Acetamide," by Mr. E. W. Prevost.

PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

After the reading of the papers by Dr. Tripe, Mr. Heisch, and Mr. Angell, "On the Methods of Taking the Melting-Point of Fats," at the meeting held May 5th (see p. 228), the following discussion ensued:—

Dr. Redwood described a method which he had adopted. He had had some experience, and found great difficulty in determining with certainty the melting-point of fats, such as tallow, &c. The tubes to which Mr. Heisch had referred were extremely similar to those mentioned by Mr. Duffy many years ago. That gentleman found that fats such as tallow and stearine had two different melting-points, according to the difference of the treatment to which they had previously been subjected; for instance, the same sample of tallow after being clarified and freed from water will give two melting-points varying by 20° F., the variation depending upon whether it had been previously melted at a temperature considerably above its melting-point or at exactly its melting-point. The ordinary clarified tallow of commerce, melted at a very high temperature, shows a melting-point of 95° or 96° F. If carefully re-melted at that temperature, and then cooled, and the melting-point again taken, it will then be found to be 115° or 116° F., being about 20° higher. The capillary tube used by Mr. Duffy and Mr. Heisch is better adapted to give accurate results than the floats, because of the smaller quantity of fat acted upon. He (Dr. Redwood) was also in the habit of using a test-tube ½ or ¾ of an inch in diameter, containing mercury, with a thermometer immersed in it. A small portion of the melted fat—say 1 grain—is dropped upon the surface of the mercury. The tube is immersed in a water-bath, the water being above the level of the mercury. The temperature of the mercury will be alike throughout, and the melting-point will be shown by the drop of fat becoming transparent and flowing over the surface of the mercury. This is an easy and reliable method of working upon tallow. Numerous experiments made, on determining the solidifying point of fats, have demonstrated the great difficulty of obtaining uniform results.

Dr. Stevenson pointed out that although there was no difficulty in getting accordant results from the same sample of butter, by experimenting in different ways, yet when different samples were taken, the genuineness of which was assured, the results were sometimes anomalous, and this may not be surprising bearing in mind the difference existing between certain fats. The substance called "butterine" gives a higher melting-point than genuine butter.

Mr. Wanklyn remarked that the thickness of the glass tubes used might seriously affect the indications of temperature, owing to the low conducting power of glass.

Dr. Dupré expressed his decided preference for the capillary tube. He, however, considered it essential that the samples of fat should be subjected for an hour or so to a uniform temperature before commencing the experiment. It was also important that the beaker in which the tubes of fat are to be placed should be itself put into a larger

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beaker, also containing water, and that the temperature should not rise more rapidly than one degree in ten minutes.

At the meeting on June 1st Mr. WIGNER read a paper on—

THE PROBABLE WORKING OF THE NEW ACT AS COMPARED WITH THE OLD.

As this is probably the last opportunity which we, as a Society, shall have of discussing the Sale of Food and Drugs Bill before it becomes Law, it seems desirable that we should consider what differences there are between the Bill in its present state and the old Adulteration Act, and then consider the objectionable provisions which still remain in the Bill.

It will be in your recollection that there are two Adulteration Acts (those of 1860 and 1872) still in force, the latter one incorporating the former. We may therefore proceed with the comparison between the 1872 Act and the "Sale of Food and Drugs Bill, 1875."

The preamble of the "Adulteration of Food Act, 1872," recites that "the practice of adulterating articles of food and drink for sale in fraud of Her Majesty's subjects, and to the great hurt of their health and danger to their lives, requires to be repressed." And the preamble of the Act of 1860 was almost identical. The Bill now before us contents itself with stating that "it is desirable that the Acts now in force relating to the adulteration of food should be repealed, and that the law regarding the sale of food and drugs in a pure and genuine condition should be amended." It will thus be seen that the older Acts took for their basis the act of fraud, which is ignored in the preamble of the 1875 Bill.

The Act of 1872, whilst providing for the punishment of persons found guilty of adulterating articles of food and drink, omitted to give any definition of what constituted "adulteration" or what was to be understood by "any article of food or drink." It therefore remained for the Courts to decide what adulteration was, and they virtually—if not actually—construed it to be "impurity." In the 1875 Bill, not only is there no definition of "adulteration," or of an adulterated article, but the very word adulteration is carefully eschewed. The term "food" is, however, defined as "every article used for food or drink by man other than drugs or water, and is perhaps as clear and comprehensive a definition as could be desired. It should be carefully noted that under this Act no Public Analyst can be called upon to make any water analyses, and this is, so far, a gain, as under the old Act some authorities held that water was included. Leaving out of consideration the clauses in both Bills where a *knowledge* of adulteration on the part of the manufacturer or vendor has to be proved, we may compare the acting clauses of the two bills.

The first clause of the 1872 Act makes it an offence to sell an article adulterated with "any injurious or poisonous ingredient." The suggestion made by us has been adopted, and the new Bill says with any "ingredient or material so as to *render* the article injurious to health." The improvement is obvious.

The second clause in the old Act makes it punishable for any person to sell "as unadulterated any article of food or drink, or any drug which is adulterated."

Clause 5 in the new Bill enacts that "No person shall sell to the prejudice of the purchaser any article of food or any drug which is not of the nature, substance, and quality of the article demanded." This clause is qualified by certain "exceptions," which have undergone most remarkable changes as the Bill has passed through Committee; but though it would be easy to quibble as to some of them, even in their present state, yet on the whole—looked at in a common-sense way—I think they are not open to objection. Remembering that the old Act contained no definition of adulteration, but only said that an adulterated article should not be sold, I submit that the new Act holds out but little hope of amelioration for persons selling adulterated or spurious articles.

The old Act contained no comprehensive provision as to drugs, but referred us to two previous Acts, and enacted in addition that no drug should be knowingly mixed with "any substance with intent fraudulently to increase its weight or bulk." In clauses 4 and 6 of the 1875 Bill very comprehensive regulations are laid down; thus—

4. No person shall, except for the purpose of compounding as hereinafter described, mix, colour, stain, or powder, or order or permit any other person to mix, colour, stain, or powder, any drug with any ingredient or material *so as to affect injuriously the quality or potency of such drug*, with intent that the same may be sold in that state, and no person shall knowingly sell any such drug so mixed, coloured, stained, or powdered, under the same penalty in each case respectively as in the preceding section for a first and subsequent offence.

6. No person shall sell any compounded drugs except the same shall be compounded in accordance with the demand of the purchaser, or with the prescription in writing of a registered medical practitioner, or with the regulations prescribed by the British Pharmacopœia issued by the General Medical Council, or in Great Britain with a basis to be laid down by the Council of Pharmaceutical Society of Great Britain, or the Privy Council, or in accordance with the provisions of the Pharmacy Act, 1868, or in Ireland in accordance with the Act of the session of the thirty-third and thirty-fourth of Victoria, chapter twenty-six, under a penalty of twenty pounds.

The importance of the words "so as to affect injuriously the quality or potency of such drug" is self-evident.

Clause 6 also makes an important provision as to compound articles of food. It says:—

6. No person shall sell any compound article of food which is not composed of ingredients in accordance with the demand of the purchaser, under a penalty of twenty pounds.

This is perhaps somewhat obscure; but if I understand it aright it would ensure a purchaser getting what he wanted, even if he did not require an unmixed article: thus if a man (as many people do) wanted a mixture of coffee and chicory, it would be compulsory on the vendor to supply coffee mixed with *chicory*, and not with some other adulterant, as, for instance, roasted acorns.

Clause 3 in the old Act says that, in the case of "mixed" articles the admixture shall be "declared," but it does not say *how*. The Courts have repeatedly held that verbal declaration was the only declaration contemplated by this clause, and there have been numerous convictions for selling mixtures of coffee and chicory even when they have been so labelled.

Clause 7 in the new Bill enacts that in cases of "mixtures" the article shall be accompanied by a "label distinctly and legibly written or printed," declaring the admixture.

The Act of 1872 contains no provision forbidding the abstraction of any important constituent of an article of food, and although in several districts the magistrates have convicted in cases of "skim" milk, the convictions have, I consider, been obtained by straining the Act of Parliament. This omission is supplied by clause 8 of the Bill of the present year, where it is provided—

8. No person shall, with the intent that the same may be sold in its altered state without notice, abstract from an article of food any part of it so as to affect injuriously its quality, substance, or nature, and no person shall sell any article so altered without making disclosure of the alteration, under a penalty in each case of twenty pounds.

Clause 9 in the old Bill and clause 11 in the new relate to the analysis of articles of food brought by purchasers other than duly appointed inspectors; and in this case the old Act is the best, inasmuch as under it such purchasers had to take their samples to the inspectors, whereas under

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the new Bill they are to take them direct to the Analysts. This I consider very objectionable; and as the inconvenience and undesirability of such a system has been repeatedly pointed out, and as no reason for its enactment has been given, I am at a loss to know on what ground our legislators have insisted upon its retention.

Clause 5 in the old and clause 9 in the new Bill relate to the appointment of Analysts, and they are practically identical, except that in *future* no person engaged in any trade connected with the sale of food or drugs shall be eligible for the appointment of Public Analysts for the place where such business is carried on. This will, however, of course not interfere with any appointments already made.

Clause 6 in the old Act and clause 12 in the new relate to the purchase of samples by inspectors duly appointed, but though the intention of the framers of the two measures may have been substantially the same, the wording is different. The first says—

"The Inspector, &c., . . *shall* procure and submit samples of articles of food or drink and drugs suspected to be adulterated to be analysed by the Analysts, &c."

The second reads—

12. Any medical officer of health, inspector of nuisances, or inspector of weights and measures, or any inspector of a market, or any police constable under the direction and at the cost of the local authority appointing such officer, inspector, or constable, *may* procure any sample of food or drugs, *and if he suspect the same to have been sold to him* contrary to any provision of this Act, shall submit the same to be analysed by the Analyst of the district or place for which he acts, and such Analyst shall with all convenient speed analyse the same and give a certificate to such officer, wherein he shall specify the result of the analysis.

Now it will be seen that a strict interpretation of the clause last read might lead to consequences amounting to the ludicrous; as an inspector after having, in pursuance of his instructions, purchased certain samples is only bound to take them to the Analyst *if* he suspects them to be adulterated. An unsuspicious inspector might therefore (feeling quite satisfied of the quality of the goods he had bought) decide not to trouble the Analyst with them, but take them home for his household consumption instead. Absurd as this is it is really, I imagine, of little moment, as it may safely be left to the local authorities to give explicit instructions to their inspectors that when articles are bought with public money for the purpose of analysis they *shall* be analysed.

Clause 12 also provides that Medical Officers of Health and policemen may be appointed as inspectors. The former certainly seems a useful addition.

One of the most important points in the Act is that relating to sealing and dividing, and the rule laid down in the new Bill is very objectionable. Up to now (as everybody knows) the inspector has taken the whole of the sample to the Analyst, where it has been divided into two parts, the inspector retaining one which the Analyst has duly secured and sealed: but in clause 13 of the new Bill the inspector is to divide the sample *on purchasing it* into three parts, hand one part back to the vendor, keep one himself, and take the third one only to the Analyst. It will be at once seen that if there were any collusion between the vendor and the inspector, or, for that matter, between the vendor and a private purchaser, the Analyst might be placed in a very awkward predicament. Thus, the purchaser goes to the shop of a friend of his, and seals up three packets. Two of them are pure coffee, and the other contains 50 per cent of chicory. Of the two pure ones, he takes one home with him, and hands the other back to the vendor. The adulterated one he then takes to the Analyst, who of course certifies to the adulteration. The vendor disputes the analysis; a second analysis is ordered of the purchaser's, or the vendor's portion, or of both. The coffee is found to be pure, and the Analyst is stigmatised as "incompetent." There is not much objection to the proposal to leave one portion with the vendor, but the remainder should certainly be brought as now to the Analyst and divided by him, so that at least one authenticated duplicate sample should still remain. The Government have had the matter repeatedly pointed out to themboth in and out of the House, and their only objection to such an obviously just proposal is that it does not fit in with the clause authorising transmission of samples by post. In the new Bill no provision is made for allowing a vendor to accompany a purchaser to the Analyst.

We may summarise the remaining new points in the Bill before us.

Clause 16 provides a penalty in the case of a vendor refusing to supply an inspector.

Clause 18 orders that all local authorities shall make an annual report to the Local Government Board, giving particulars of the working of the Act in their districts.

Clause 20 gives the right to a defendant to tender himself or his wife as witnesses for the defence.

Clause 21 is the much-canvassed Somerset House clause, and is entirely objectionable, though it appears to be inevitable. I may just point out three things in it.

(1.) It says the justices "may" send samples to be analysed there, not that they *shall*.

(2.) Nothing is said *pro* or *con* as to the Analyst being required to attend and give evidence; and in the absence of this it is as probable as not that the magistrate would *not* enforce attendance.

(3.) No form of certificate is prescribed for the Inland Revenue chemists to use, though a form for the Public Analysts is carefully drawn out.

Clause 24 meets a just complaint on the part of the tradesman by allowing him to go free on the production of a warranty from the wholesale dealer, and clause 26 makes the forgery of such a warranty penal.

Clause 25 provides for the fines in every case going to the local authorities, to be applied towards the expenses of the Act.

In the discussion which followed the reading of this paper no difference of opinion was expressed as to the conclusions at which Mr. Wigner had arrived.

Dr. Bernays, after stating his opinion as to the value of the paper, and to the obligation which the Society owed to Mr. Wigner for his exertions in reference to the sale of Food and Drugs Bill, related a case in his experience corroborative of the fact that samples are sometimes tampered with.

Dr. Dupré particularly objected to Clause 11, on the ground that it allowed a purchaser to bring samples direct to the Analyst, and to claim a certificate addressed to him personally, which might afterwards be used as a trade advertisement. He also insisted very strongly on the very objectionable provisions in clause 13 as to sealing and dividing samples, and to illustrate the danger to which Analysts will be exposed if it remains unaltered, referred to a beer case in which he was concerned recently, and particulars of which were published in Chemical News, vol. xxxi., p. 235. The speaker next adverted to clause 21, and pointed out the injustice of taking the mere *ipse dixit* of an official at Somerset House as against the duly authenticated certificate of a Public Analyst of repute; and he argued that, unless the Inland Revenue *employés* were compelled to attend the adjourned hearing of disputed cases and verify their results on oath, it would be impossible for Public Analysts to retain their appointments with due regard to their self-respect. Dr. Dupré added—I will not say anything against the chemists of Somerset House, because I know very little of them I may say that I know of no improvement in analysis which could be traced home to Somerset House; whereas we know that there are a number of Public Analysts appointed who have been before the public for years, and who have themselves discovered processes by means of which the public can judge them. It seems to me entirely inadmissible that such men should be put below

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the level of the officials at Somerset House. All their work is done, of course, officially, and, as far as I am aware, it never comes fairly before the public. Now I should be sorry if it were understood that I object to have my analyses checked at all; on the contrary, I think the check is exceedingly useful. It keeps us all up to the mark; but, whoever has to check my analysis, must do as I have to do. That is to say, if I require it, he ought to appear in court, and ought to tell me "I found such and such a thing, and I found it in such and such a manner." (Hear, hear.) If that is done, I do not care whoever checks my analysis.

Mr. Allen (Sheffield) gave additional instances of the improper substitution of samples.

Dr. Tripe said—I merely desire to express my approbation of what has been said in this matter. I feel very strongly that, if the Bill should pass as it now is, we should be in the hands completely of any unscrupulous man of whom purchases of food may be made. And, indeed, if we consider that, when a man is unscrupulous enough to adulterate food, and to sell as pure an article which is not pure, I think it is not drawing the string too tightly to suppose that he may carry the matter a little bit further, and do as has been done in many cases, substitute one article for another.

Mr. Angell (Southampton) next addressed the meeting, dealing chiefly with the clause in the Bill as to the forwarding samples by post.

Mr. Horsley (Cheltenham), who announced himself as "the first county Analyst ever appointed," speaking on the same clause, described the plan he adopted for the reception of samples by means of the police force.

The Chairman—I should wish to remark how very complete the proof is that Dr. Dupré's two samples, which were legally identical, were not identical in fact. Here are two samples legally identical. These samples yield respectively 40 of chlorine and 136. This determination was made with the same solution of silver. Now, we all of us are in the habit of making these determinations of chlorine with silver solution, and we know that it is quite impossible, if the samples are identical, to return the one as 40 and the other as 136. The two same samples were examined for alcohol, and found different. It is very fortunate that the case was capable of being dealt with in so complete a manner, and it is fortunate that a chemist who stands so high as Dr. Dupré had these samples before him, and that we are able to point to a case in which we can say absolutely that the legal precautions which had been taken to procure identity of sample are not sufficient. As to Somerset House, Mr. Sclater-Booth explained to Dr. Redwood and myself, when we waited upon him, that one of the chief reasons, if not the very reason, why the Government proposed this reference to Somerset House was, that it was very economical and it would cost comparatively nothing.

Dr. Dupré—If it is so very economical, we shall have many cases referred.

In reply, Mr. Wigner said that Mr. Clare Read told him distinctly that Mr. Sclater-Booth's intention was that the chemists of the Inland Revenue should come into court. Mr. Sclater-Booth confirmed that in his hearing, when speaking in Committee, and a Somerset House official, in a letter which was put into his hands, also confirmed it. But still it is perfectly clear that the Act does not enforce it, and therefore he thought that we ought to have some resolution this afternoon instructing us to get inserted in the act some words which will carry that out.

THE SALE OF FOOD AND DRUGS BILL.

The Sale of Food and Drugs Bill passed its second reading in the House of Lords on the 7th inst., on the motion of the Duke of Richmond. In the discussion, Lord Redesdale pointed out that Clause 7 (relating to mixed articles, should provide that the label declaring an article to be mixed should also state what substance it is mixed with and the proportion of the foreign ingredient.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 18, May 10, 1875.

Presence of Anhydrous Sulphuric Acid in the Gaseous Products of the Combustion of Iron Pyrites.—A. Scheurer Kestner.—The white fumes which accompany the sulphurous acid produced by the combustion of pyrites have been ascribed to sulphuric acid, due to the concourse of the sulphurous acid and of the moisture contained in the pyrites. But these vapours are formed with equal facility from dry pyrites, and on examination we find that they are condensed with difficulty, and that they are chiefly composed of anhydrous sulphuric acid, to the formation of which moisture or water can have contributed nothing. The sulphurous acid produced by the combustion of sulphide of iron in pyrites-kilns is in prolonged contact with very hot walls of masonry, or of pyrites completely or imperfectly burnt. Hence it follows that anhydrous sulphuric acid can only be formed by the decomposition of the sulphurous acid itself, or by its oxidation, the two phenomena being occasioned by the great heat to which the gases are exposed. Direct experiment proves that sulphurous acid is not decomposed, even at a temperature higher than that of pyrites-kilns. Its aqueous solution is easily decomposed; if heated to 200° in a sealed tube, into sulphuric acid, and a deposit of free sulphur, but the gaseous acid resists heat. The presence of anhydrous sulphurous acid must therefore be ascribed to the oxidation of sulphurous acid. The sulphurous gas in pyrites-kilns being mixed with large quantities of air, we are naturally led to suppose that the elevated temperature favours the combination of atmospheric oxygen with sulphurous acid. To determine this point, the author passed sulphurous acid, mixed with double its volume of air, through a platinum tube of 40 centimetres in length, and heated to redness. The gases before entering the tube traverse a solution of chloride of barium to serve as a proof of the absence of sulphuric acid before their passage through the tube. A solution of chloride of barium, which the gases traversed after issuing from the tube remained perfectly clear. No white vapour was perceived; consequently there was no trace of the formation of anhydrous sulphuric acid. To explain the oxidation of the sulphurous acid there remains merely the intervention of the oxygen of the ferric oxide already formed by the combustion of the sulphur of the pyrites. Further experiments proved, in fact, that the sulphurous acid is oxidised at the expense of the oxygen of the ferric oxide. This is a new instance of the remarkable oxidising powers of ferric oxide which serves to transfer oxygen from the atmosphere to the oxidisable body.* The presence of sulphuric acid in the gases derived from the combustion of pyrites explains, to a certain extent, the default of oxygen which has been observed in these gases at the moment when they are directed into the leaden chambers for the manufacture of sulphuric acid. When these gases are analysed we never find a quantity of oxygen sufficient to represent, with the sulphurous acid which they contain, and the oxygen combined with the iron of the pyrites, all the oxygen of the air which has served to support the combustion of the sulphide of iron. The following is a comparison between the composition of the gas of a pyrites-kiln as found, and as calculated on the basis of 4·34 per cent of sulphurous acid:—

	Found.	Calculated.
Sulphurous acid	4·34	4·34
Oxygen	11·18	15·41
Nitrogen	84·48	80·25

* *Comptes Rendus*, xlix., pp. 257, 428, and 968.

Moniteur Scientifique, du Dr. Quesneville, April, 1875.

On Eosin.—A. W. Hofmann.—From the *Berichte der Deutschen Chem. Gesselschaft*.

On Mesidin.—A. W. Hofmann.—From the same source.

Chemical Constitution of Chloride of Lime.—W. Woltera.—A long dissertation, incapable of useful abstraction.

Use of the Oils of Coal in the Preparation of the Alkaloids.—MM. G. Boiraux and E. Léger.—The author's have been engaged with experiments on the use of certain oils of coal as substitutes for alcohol in the preparation of the alkaloids. They have investigated, for this purpose, benzols boiling from 50° to 100°; common benzol boiling from 80° to 120°, and a mixture of the foregoing with 5 per cent of phenic acid. They remark that vegetable matters to be treated with benzol must previously be dried with the utmost care.

Action of Organic Acids upon the Natural Alkaloids.—G. H. Beckett and R. Alder Wright.—From the English.

Chemical Products at the Exhibition of Vienna.—M. E. Kopp.—An account of the fatty bodies, and the products of destructive distillation.

Analysis of Ores of Nickel and Cobalt.—R. Fresenius.—From the *Zeitschrift fur Analytische Chemie*.

Varieties in Analytical Chemistry.—A collection of paragraphs taken from the *Zeitschrift fur Analytische Chemie*, the Chemical News, and the *Berichte der Deutschen Chemischen Gesselschaft*.

Researches on the Combination of Grape-Sugar with Copper, and on Frommherz's Assay.—E. Salkowski states that, if in testing diabetic urine the sulphate of copper is added without precaution, the precipitate formed does not re-dissolve, and the filtrate is colourless, feebly alkaline, containing neither copper nor sugar, or at most a trace of sugar. The bulk of the sugar is in the precipitate, and is held with such force that it cannot be withdrawn by prolonged washings. If we mix 1 atom of sugar, 5 atoms of sulphate of copper, and 10 atoms of hydrate of soda, the filtrate contains no sugar, and the precipitate dissolves readily in the soda-lye; and, if the liquid is heated, all the copper is thrown down as suboxide, whilst the sugar is destroyed. If these proportions are exceeded, hydrated oxide of copper is mixed with the precipitate.

Aniline Black Marking Ink.—Dr. Jacobsen.—To prepare this ink the two following solutions are required:—(1.) Dissolve in 60 grms. of water 8·52 grms. crystalline chloride of copper, 10·65 grms. chlorate of soda, and 5·35 grms. chloride of ammonium. (2.) Dissolve 20 grms. hydrochlorate of aniline in 30 grms. of distilled water, and add 20 grms. solution of gum arabic (1 part of gum to 2 of water), and 10 grms. glycerin. If 4 parts of the aniline liquid are mixed in the cold with 1 part of the copper solution we obtain a greenish liquid, which may be used at once for marking linen; but as it decomposes in a few days it is better to preserve the two solutions separately. The writing is at first greenish, but is blackened by exposure to steam (*e.g.*, by being held over the spout of a boiling kettle). A dry heat renders the tissue brittle.

Means of Promoting the Germination of Seeds.—A dilute solution of ammonia, potash, or soda, has a remarkable power of hastening the sprouting of seeds, especially of coffee, which germinate with difficulty.

Action of Acids on the Essence of Peppermint.—From the *Journal of the Chemical Society*.

Action of Bromine in Presence of Water on Bromo-Pyrogallol and Bromo-Pyrocatechin.—Dr. Stenhouse.

Action of Bromine on Pyrocatechic, Gallic, and Tannic Acids.—Dr. Stenhouse.

Propionic Coumarin, and on Certain of its Derivatives.—W. H. Perkin.—These three papers are all taken from the *Journal of the Chemical Society*.

Addition-Product of Propylen to Hypochlorous Acid.—M. L. Henry.

Perbromide of Bromated Acetylen.—M. E. Bourgoin.—These two papers are taken from the *Comptes Rendus*.

Practical Observations on the Properties of Salicylic Acid.—Dr. Wagner.—An account of the therapeutical applications of this acid, external and internal.

Tempered Glass, and on its Resistance to Blows and to Heat.—A. de la Bastie.—An account of the experiments of M. de Lubac.

Toxicological Detection of the Cyanide of Potassium in Presence of Non-Poisonous Double Cyanides.—Already noticed.

Precipitation of Magnesia.—Dr. Mohr.—From the *Zeitschrift fur Analytische Chemie*.

Determination of Chlorine, of the Oxides of Nitrogen, and of Ferrous Oxide in Commercial Iron Mordant.—M. H. Vohl.—The chlorine is separated by sulphate of silver, and the filtrate treated with caustic baryta till it has a strongly alkaline reaction. The precipitate is digested for some hours at 100° till it becomes compact. Carbonic acid is then passed through the filtrate to remove excess of baryta, and in the liquid nitrites are tested for with starch-paste and iodide of potassium. If nitrites are present a known quantity of the liquid is evaporated to dryness, and the residue is digested with absolute alcohol, in which nitrite of baryta dissolves, whilst nitrate remains insoluble. In this case, the baryta found in the insoluble part is precipitated as sulphate, and weighed, or determined volumetrically. The total baryta is then found in another portion of the solution of the mixed salts, and the quantities of nitrate and nitrite are thus determined. To determine the ferrous salts, the liquid is diluted with water, and digested with recently precipitated carbonate of lime in a flask provided with a stopper, and with a delivery tube dipping into mercury. When the liquid is clear, and no more gas escapes, it is filtered with the exclusion of air, and the precipitate is washed. The iron in the filtrate is peroxidised with hydrochloric acid and chlorate of potash, and then precipitated with ammonia.

Determination of Sulphur in Coal and Coke.—M. A. Eschka.—Powder as finely as possible 1 grm. of the sample, and mix intimately with 1 grm. of calcined magnesia and 0·5 grm. of anhydrous carbonate of soda. Heat over the lamp in an open platinum crucible, inclined so that only its lower half may be brought to a red heat. The ignition requires from forty-five to sixty minutes, and the mixture should be stirred every five minutes with a platinum wire. The process is complete when the ash becomes yellowish or brownish. Let it become quite cold, and mix intimately with the ash, by means of a glass rod, ½ to 1 grm. nitrate of ammonia, and heat to redness for five to ten minutes, the crucible being covered with its lid. The residue is then placed in a precipitating glass and covered with water. The residue adhering to the crucible is detached by heating with the liquid, and the washings are added to the solution in the glass. The sulphuric acid is then determined in the usual manner.

Les Mondes, Revue Hebdomadaire des Sciences. No. 14, April 8, 1875.

Analysis of Sugars.—Emile Viard.—The maximum of exactitude is reached by using, for crystalline samples, the saccharimeter with penumbræ (with inversion for the analysis of beet-root and of cane sugars); for glucose, the liquid of Monier, which is preferable to every other; for moisture, the stove of Weissnegg; and for the ash, the sulphuric incineration. Here there is a doubt whether we

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should deduct from the weight of the sulphated ash one-tenth or two-tenths.

Magneto-Faradic Apparatus of Clarke as Modified by Gaiffe.—This paper requires an illustration.

Statical Electricity.—Prof. Volpicelli.—This paper also requires the accompanying illustrations.

No. 15, April 15, 1875.

M. Alvaro Reynoso recommends the use in agriculture of lepidolite, a mineral said to contain fluorine, potash, lithia, *nitridium*, and phosphoric acid. Its present price is declared quite unimportant, since "whenever a substance has entered into ordinary use its price has fallen." The escape of fluorine from phosphate is said to considerably reduce their fertilising value.

Manure for Beet-Root.—

Acid phosphate of lime	300 kils.
Chloride of potassium	200 ,,
Nitrate of soda	500 ,,

Liebig's Annalen der Chemie und Pharmacie.
Band 176, Heft 2, April 5, 1875.

Communications from the Laboratory of Prof. V. Meyer, in Zürich.—These communications consist of investigations on the constitution of the bi-substituted benzols, by Dr. C. Wurster; and of a paper on the mercaptanesters, by Dr. W. Michler.

Notice on Substituted Phenols.—Theodor Petersen.—A reply to certain remarks of A. Faust on the dinitrochlorphenols. (*Berichte*, 6, 369; *Liebig's Annalen*, 173, 318, and 157, 161.)

Behaviour of the Solutions of Certain Substances with Polarised Light.—O. Hesse.—(Conclusion.) This valuable paper is not capable of useful abstraction.

Improvement in Erdmann's Floats.—The author, admitting the value of Erdmann's floats in reading off the position of the liquid in a burette, points out that they are open to one serious objection. They generally become lined internally with a green or yellow layer, from the oxidation of the mercury, and are thus rendered opaque, and consequently useless. He proposes to place the mercury in a distinct cell, hermetically sealed from the upper part of the float which carries the circular mark. He has had floats of this construction in use for years.

Analysis of the Sulphuretted Water of Ber Keraui, in the Libyan Desert.—Julius Hessert.—1000 parts of this water contain—

Free sulphuretted hydrogen	0·0182
Chloride of potassium	0·1344
Chloride of sodium	1·1223
Bicarbonate of lime	0·7480
Sulphate of lime	1·0722
Bicarbonate of magnesia	0·0962
Sulphate of magnesia	0·2373
Bicarbonate of iron (protoxide) ..	0·0555
Alumina	0·0236
Phosphoric acid	0·0051
Silica	0·0327
Organic matter	0·0756
Nitric acid	trace
Lithia	trace

MISCELLANEOUS.

Sulphide of Antimony versus Binoxide of Manganese.—In the Irish Court of Queen's Bench, on May 29th, a motion was made and granted to draw out of court a sum of £1500 tendered by the Governor and Directors of the Apothecaries Hall of Ireland as compensation for the consequences of their mistake in selling a packet of sulphide of antimony for oxide of manganese. Through the explosion of the sulphide, a man, named Marsden, lost his life, and his wife and children were wounded.

The Sulphur-Beds of the Island of Saba.—We have received an interesting description, by Professor Gesner, of a visit made by him to the sulphur-beds of the Island of Saba. He says—"Our destination was Spring Bay, where the beds of sulphur bearing gypsum show their greatest outcrop, and Great Hole, which adjoins it. The men were engaged in removing the overburden, some eight feet of sand and gravel, when we arrived, and in breaking down the crude brimstone from the face of the bed, which is 40 feet in thickness at this point, and extends into the hill under the volcanic cap for an indefinite distance. Going towards Flat Point, which lies between Great Hole and Spring Bay, and descending the cliff a little, one can obtain a view of the face of the vast bed of brimstone, which shows the yellow features in all the places when the overburden has been removed, and in weather-worn places stands out distinctly. At one place a fissure nearly 2 feet in width, lined with yellow crystal so far as we could see, was sounded with a line for 40 feet. The mass of the bed is gypsum, bearing sulphur to a greater or less degree, 60 per cent being the average of sulphur. In many places masses of sulphur, quite pure and resembling melted brimstone, poured into irregular moulds, could be had, hundreds of pounds in weight. The fires died out in Saba so long ago that the sulphur-beds are perfectly cold, and no gases arise to interrupt the working of the sulphur quarry, the workmen carrying on their operations as easily as if in a bank of stiff clay. We trace the bed to Flat Point, and agree as to what Spring Bay will show when its outcrops have been explored with pick and shovel. We discuss the shipping facilities, and agree that a wire tramway from the edge of the quarry to Green Key will be the way to do the transportation to the lighters. I have seen what I believe to be one of the largest, and certainly the richest and most accessible, deposits of brimstone in the world." Mr. G. G. Blackwell sends us the following:—

Analysis of Saba Sulphur.

No. 1.

Sulphur	80·57
Silicate and sulphate of lime	14·90
Water	4·53
	100·00

No. 2.

Sulphur	75·81
Silicate and sulphate of lime	20·56
Water	3·63
	100·00

MEETINGS FOR THE WEEK.

MONDAY, June 14th.—Geographical, 8.30.
TUESDAY, 15th.—Zoological, 8.30.
WEDNESDAY, 16th.—Meteorological, 7.
THURSDAY, 17th.—Royal, 8.30.
—— Zoological, 4.
—— Philosophical Club, 6.
Chemical, 8. "On Nitrosyl Bromide and on Sulphur Bromide," by M. M. P. Muir. "Notes on the Chemistry of Tartaric and Citric Acids," by R. Warington. "On the Action of Nitric Acid on Copper, Mercury, &c., especially in the Presence of Metallic Nitrates," G. J. J. Ackworth. "Decomposition of Water by the Joint Action of Aluminium Iodide, Bromide, or Chloride, including Instances of Reverse Action," by Dr. Gladstone and Mr. Tribe. "On Achrematite, a new Molybdo-Arseniate of Lead." "New Reactions of Tungsten," by Prof. Mallet. "On the Action of Chlorine on Acemetide," by E. W. Prevost.

GEOLOGY.—Elementary Collections to illustrate the new edition of Lyell's "Students' Elements of Geology," and facilitate the important study of this science, can be had at 2, 5, 10, 20, 50, to 1000 guineas. Also single specimens of Rocks, Minerals, Fossils, and recent Shells. Geological Maps, Hammers, all the recent publications, &c., of J. Tennant, Mineralogist to Her Majesty, 149, Strand, London.

Practical Instruction is given in Geology and Mineralogy by Professor Tennant, F.R.G.S., at his residence, 149, Strand (W.C.).

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THE CHEMICAL NEWS.

Vol. XXXI. No. 812.

THE ACTION OF NESSLER TEST ON RAIN-WATER.

By WILLIAM H. WATSON.

I have read Mr. Thomas Garside's "Laboratory Notes," in Chemical News, vol. xxxi., p. 245. The second paragraph is on the "Action of Nessler Test on Rain-Water," he having noticed a muddy appearance produced in rain-water on addition of the Nessler reagent, for which he is unable to account. I have observed very often the same effect with spring- as well as rain-water, and find that it is due to salts of magnesia present in the water. A very slight amount of magnesium chloride in a sample of water produces a distinct muddiness with the Nessler test. Rain-water doubtless obtains its magnesia for the most part in the form of chloride from spray from the sea, and Mr. Garside's sample, collected at Southport (near to the sea), would very likely be pretty considerably contaminated with magnesium chloride.

Below are the analyses of two samples of rain. No. 1, fallen about a mile from the sea; No. 2, fallen about 50 yards from the sea, at Braystones, near Whitehaven.

	Parts per 100 000 parts.
No. 1.	
Total solids	5·67
Containing—	
Sodium chloride	2·45
Magnesium chloride	0·67
No. 2.	
Total solids	17·10
Containing—	
Sodium chloride	12·20
Magnesium chloride	3·43

Chemical Laboratory, Braystones, near Whitehaven, June 7, 1875.

NATIVE SODIUM NITRATE, OR "CALICHE."

By Dr. A. T. MACHATTIE, F.C.S., Glasgow.

Analyses of native sodium nitrate, or *caliche*, by which latter term it is known in South America, are not very numerous in chemical text-books; and, as I have had occasion to examine some samples brought direct from Peru, a note of the results may be of sufficient interest for record.

The samples were—(1) *White caliche*, in solid compact masses; (2) *brown caliche*, in masses not so compact as the white, mixed with a considerable amount of earthy matter, and having an appearance somewhat similar to impure rock-salt; and (3) a sample of *mother liquor* obtained during the treatment of the white caliche above mentioned, in Peru, previous to shipping the crude nitrate for exportation.

Analyses.

	No. 1. White Caliche.	No. 2. Brown Caliche.
Sodium nitrate	70·62	60·97
Sodium iodate	1·90	0·73
Sodium chloride	22·39	16·85
Sodium sulphate	1·80	4·56
Calcium sulphate	0·87	1·31
Magnesium sulphate	0·51	5·88
Insoluble matter	0·92	4·06
Water	0·99	5·64
	100·00	100·00

The iodine appeared to exist almost entirely as sodium iodate.

The *mother liquor* (No. 3) had the sp. gr. 1440·1 (water = 1000), and five samples gave, as an average of closely accordant results, 0·56 per cent of iodine, equivalent to sodium iodate, 0·873. In this case, also, the iodine appeared to be present in the condition of sodium iodate.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from page 255).

The air is driven, by means of a blast, at a pressure of 3 to 4 c.m. of mercury through a sheet-iron box filled with caustic lime, and then conducted into the retort from above. The temperature of the latter can be judged by means of an aperture, which can be closed with an iron stopper. The air gives off only about the half of its oxygen, so that, for 1 volume of oxygen, 10 volumes of air must be passed through, the residue escaping into the atmosphere.† In about five minutes the revivification of the reduced mass is completed, when the stream of air is cut off by means of a cock with a triple perforation, and a current of superheated steam is passed through for five minutes, whilst immediately afterwards the gas which issues below the grate is conducted into condensers. Here a fine descending rain of cold water frees the oxygen from steam, and it enters the gasometer under the pressure of a column of water of from 8 to 10 c.m. in height. In this manner, reduction and oxidation alternate at intervals of five minutes. Not until six hours have elapsed does it become necessary for a more complete revivification of the mass to pass atmospheric air over it for an hour, for in five to six hours the yield of oxygen sinks from its original quantity down to the half, or even the third. The cocks are set at Vienna by a self-acting movement. The longer watery vapour is introduced, and the retorts thus freed from atmospheric air before opening the communication with the gasometer, the purer is the oxygen. Half a minute suffices to bring down the nitrogen to 15 per cent if the useless space in the retorts is kept as small as possible. If, as is easily practicable, the nitrogen is brought down to 4 per cent, there is a greater waste of oxygen. To be certain that the amount of nitrogen remains within the limits of from 10 to 15 per cent, samples are taken from the gasometer in graduated tubes, and the oxygen is absorbed by means of known quantities of potash and pyrogallic acid, a reaction which, even in inexperienced hands, gives quick and accurate results.

As any cooling of the retorts below a dark red heat diminishes the yield, care is taken to heat both the air and steam to about 300° C. At Pantin, where there are several groups of ten retorts each, two of them are filled with pumice-stone, and serve for heating the air and the steam. The composition of the mass is 2 molecules of NaOH, 1 molecule of MnO_2, and the fifth of a molecule of oxide of copper, which merely serves to separate the other ingredients and render them more accessible to the influence of steam and air. At Comines, the black oxide of manganese is regenerated in the ordinary manner from chlorine residues, and is almost pure; its price is 2 francs per kilo. The great cost of this fundamental article is not of importance, since it can be used the longer the more carefully the air is freed from carbonic acid. If, in con-

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† Latterly, Tessié du Motay has attempted to convert the escaping nitrogen industrially, first into nitride of titanium, and then into ammonia.

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sequence of some inevitable interruption of the process, the mass absorbs atmospheric carbonic acid, it is simply requisite to heat to redness, and to pass a current of steam over it till the escaping vapours cease to render lime-water turbid. The temperature is then raised and air passed over the mass, when it regains its original efficacy. The average duration of a retort is one year.

Tessié du Motay's process yields oxygen at 90 per cent, at the cost of 15 to 30 centimes per cubic metre,* or, according to the experiments of Kuppelwieser in Vienna,† 3 florins per 1000 cubic feet, a price which agrees with the former, and which scarcely exceeds that of coal-gas. We may regard this process as the final and successful solution of the problem as to the economical and rational production of oxygen.

We have still to review a group of projects which, without any chemical agents, aim at extracting oxygen from the atmosphere by a purely mechanical procedure. They are based upon two physical principles, diffusion or absorption.

THE CHEMICAL CONSTITUTION OF THE ETHYL-ETHER AND ITS CHLORINATED DERIVATIVES,

VIEWED AND INTERPRETED FROM THE STANDPOINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

(Concluded from page 247.)

PART II.

On the Chemical Action of Sodium-Ethylate on the Chlorinated Derivatives of the Ethyl-Ether and the so-called Acetal, as also on the Mode of Formation and Molecular Structure of the Ether-Salts of Ortho-Formic and Ortho-Carbonic Acids.

When the mono-chlor-ethyl-ether is treated with sodium-ethylate, the resulting product is acetal—

$$\begin{matrix} Et_2O_2.\ Et_2O_2. \\ Fo_2O_2, Me_2O_2, \end{matrix}$$

and with similar treatment the dichlor-ethyl-ether is observed to furnish chlor-acetal—

$$\begin{matrix} Et_2O_2.\ Et_2O_2. \\ \cdot\cdot \\ Fo_2O_2, Me_2O_2, \end{matrix}$$

the molecular changes consisting, in either case, in the interchange of the sodium nucleus for the formyl nucleus of the colligated formyl chloride. And, considering that, like hydrate of potash, the sodium ethylate possesses, in its soda constituent, a powerful chlorine-coveting base, I have, further, been led to infer the existence of three varieties of chloracetal—

$$\alpha)\ \begin{matrix} Et_2O_2.\ Et_2O_2. \\ Fo_2Cl_2, Sfo_2O_2 \sim Sfo_2O_2 \div \end{matrix}$$

$$\beta)\ \text{(ordinary chloracetal)}\ \begin{matrix} Et_2O_2.\ Et_2O_2. \\ \cdot\cdot \\ Fo_2O_2, Me_2O_2 \div \end{matrix}$$

$$\gamma)\ \begin{matrix} Et_2O_2. \qquad Et_2O_2. \\ Fo_2O_2, Sfo_2Cl_2 \sim Sfo_2O_2, \end{matrix}$$

corresponding to the three aforesaid varieties of hydroxyl-chlor-ether. Manifestly, the action of a second molecule of sodium-ethylate on either of these three isomerides ought to yield the same product—

$$\begin{matrix} Et_2O_2.\ Et_2O_2.\ Et_2O_2. \\ Fo_2O_2, Sfo_2O_2 \sim Sfo_2O_2. \end{matrix}$$

* Phillips, "Der Sauerstoff," 18.

† Kuppelwieser, *Berg. und Hütten Ztg.*, 1873, 354.

It is interesting to learn that this body, which is evidently the tri-ethyl-ether of the triatomic ethylidenglycolic alcohol, has actually been got and described under the name "tri-ethyl-acetal." In order to enable the reader of comprehending the precise nature of the action of sodium-ethylate on dichlor-acetal, which according to Pinner, gives rise to "glyoxal-acetal," it becomes incumbent on me to explain to him the formation of Kay's orthoformic ether. This compound is best obtained by dropping the calculated quantity of sodium into a mixture of absolute alcohol and formyl-chloride (chloroform), $2FoCl_3$, when three molecules of previously-formed sodium-ethylate conspire towards the production of one molecule of the ether and three molecules of sodium-chloride, the molecular changes being briefly as follows:—

First stage.—Interchange of ethoxyl, Et_2O_4, for chlorine, producing sodium-chloride, and dichloro-formic ether—

$$\begin{matrix} Et_2O_2. \\ 2FoCl_2O \div \end{matrix}$$

Second stage.—Splitting-up of the latter into the formous ether and two molecules of chlorine, which, by reacting upon the ethylen adjunct of the second molecule of sodium-ethylate, give rise to hydrochloric acid and sodium-chlor-ethylate, and, by the transposition of the latter products, to a second molecule of sodium-chloride and the unstable chlor-ethylic alcohol, which speedily merges into the isomeric hydrate of ethyliden-oxy-chloride—

$$\begin{matrix} H_2O_2. \\ Fo_2Cl_2, Me_2O_2 \div \end{matrix}$$

Third stage.—Chemical union of this hydrate with the aforesaid formous ether, yielding—

$$\begin{matrix} H_2O_2.\ Et_2O_2. \\ Fo_2Cl_2, Me_2O_2, 2FoO \div \end{matrix}$$

Fourth stage.—Interchange of the third molecule of sodium-ethylate for the formyl nucleus of the colligated formyl-chloride, giving as end-product the ortho-formic ether—

$$\begin{matrix} Et_2O_2.\ H_2O_2.\ Et_2O_2. \\ Fo_2O_2, Me_2O_2, 2FoO, \end{matrix}$$

and a third molecule of sodium-chloride.

This formula will now enable us to resume our enquiry into the molecular structure of Pinner's glyoxal-acetal. Assuming that, under the stimulus of the sodium-ethylate, the dichlor-acetal—

$$\begin{matrix} Et_2O_2.\ Et_2O_2. \\ \cdot\cdot \\ Fo_2O_2, Me_2O_2, \end{matrix}$$

passes first into the isomeric modification—

$$\begin{matrix} Et_2O_2.\ Et_2O_2. \\ Fo_2O_2, 2FoCl_2O, \end{matrix}$$

into which the before-mentioned dichloro-formic ether is seen to enter as one of the principal groups, and having just shown that the action of two molecules of sodium-ethylate on that ether gives birth to a molecule of ortho-formic ether, it becomes clear that Pinner's compound must be constituted according to the formula—

$$\begin{matrix} Et_2O_2.\ H_2O_2.\ Et_2O_2.\ Et_2O_2. \\ Fo_2O_2, Me_2O_2, Fo_2O_2, 2FoO, \end{matrix}$$

which represents it as the ethyl-ether of ortho-ethyl-glycolic acid. It is almost superfluous to add, that the same substance ought to be obtainable likewise by the action of sodium-ethylate on the trichlor-ethyl-ether—

$$\begin{matrix} Et_2O_2. \\ \cdot\cdot \\ Fo_2Cl_2, Me_2O_2, \end{matrix}$$

or, more correctly speaking, on the isomeric modification—

$$\begin{matrix} Et_2O_2. \\ Fo_2Cl_2, 2FoCl_2O. \end{matrix}$$

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In passing on to consider the action of sodium-ethylate on trichlor-acetal, I must confess to my want of success in gathering reliable experimental data; nevertheless, I have attempted the solution of this problem on the strength of the theoretical knowledge already gained, and, being struck with the close resemblance and evident parallelism which this case bears to the last, I have naturally been led to think that similar relations to those subsisting between the ortho-formic and ortho-ethyl-glycolic ethers might obtain likewise between the ortho-carbonic and ortho-ethyl-glyoxylic ethers, it being taken for granted that the latter combination was obtainable by the action of sodium-ethylate on trichlor-acetal. Commencing, therefore, with the ortho-carbonic ether, which may be realised by subjecting chlor-formyl-trichloride (tetra-chloride of carbon) $2FoCl_3$, to the action of sodium-ethylate, the molecular changes are briefly as follows:—

First stage.—The interchange of ethoxyl for chlorine gives rise to sodium-chloride and the trichloro-formic ether—

$$Et_2O_2.$$
$$\dot{2}FoCl_2O \div$$

Second stage.—Two molecules of sodium-ethylate, by reacting upon the latter, produce two molecules of sodium-chloride and the ortho-chloro-formic ether—

$$Et_2O_2.\ H_2O_2.\ Et_2O_2.$$
$$\dot{F}o_2O_2, Me_2O_2, 2FoO \div$$

Third stage.—The fourth molecule of sodium-ethylate, by the interchange of its ethyl nucleus for the hydrogen nucleus of the colligated methylic alcohol, gives birth to hydrate of soda and the product—

$$Et_2O_2.\ Et_2O_2.\ Et_2O_2.$$
$$\dot{F}o_2O_2, Me_2O_2, 2FoO,$$

whereupon the interchange of hydroxyl for chlorine completes the formation of the ortho-carbonic ether—

$$Et_2O_2.\ Et_2O_2.\ Et_2O_2.$$
$$\dot{F}o_2O_2, Me_2O_2, 2FoO_3,$$

while a fourth molecule of sodium-chloride is added to those previously formed.

This formula will now enable us to resume our enquiry into the molecular structure of the hypothetical ortho-ethyl-glyoxylic ether. Assuming that it is not the ordinary dichlor-acetal, but the above-mentioned isomeric modification, which is brought to furnish the trichlor-acetal—

$$Et_2O_2.\ Et_2O_2.$$
$$\dot{F}o_2O_2, 2FoCl_2O,$$

into which the trichloro-formic ether is seen to enter as one of the principal groups; and having just shown that the action of three molecules of sodium-ethylate on that ether gives birth to a molecule of ortho-carbonic ether, it becomes clear that the ether in question must be constituted according to the formula—

$$Et_2O_2.\ Et_2O_2.\ Et_2O_2.\ Et_2O_2.$$
$$\dot{F}o_2O_2, Me_2O_2, Fo_2O_2, 2FoO_3.$$

It is almost superfluous to add, that the same body ought to be obtainable likewise by the action of sodium-ethylate on the tetra-chlor-ethyl-ether—

$$Et_2O_2.$$
$$\dot{F}o_2Cl_2, 2FoCl_2O,$$

which I take to be a substitution-product of the isomeric modification—

$$Et_2O_2.$$
$$\dot{F}o_2Cl_2, 2FoCl_2O,$$

of the trichlor-ethyl-ether.

In drawing to a close, I may yet be permitted to notice one other important feature of the new theory, which is that, according to my definition of an alcohol, whereby it is viewed as a combination of two molecules of water, one or both the hydrogen nuclei of which have become dissimilarly modified by their chemical union with different hydrocarbon or halogen adjuncts, the alcoholic family includes amongst its members, not only the alcohols proper, but likewise the so-called mixed ethers. But, in striking contrast with this class of saline molecules, the chemical constitution of another class of saline molecules, comprising water, the ethyl-ether, hydrochloric acid, and ethyl-chloride, has now, I think, been fully determined and substantiated by a host of solid and weighty experimental evidence; and thus the most salient structural points and peculiarities of these prototypes of molecular arrangement have become revealed to us, at least so far as the mere juxtaposition of marks and symbols on a plane surface can be expected to accomplish it. On these grounds, I would fain persuade myself that my theory regarding the chemical constitution of the ethyl-ether and its chlorinated derivatives, although at variance with current notions and prejudices, will yet receive a full share of that serious attention and thoughtful consideration which is often so liberally and enthusiastically accorded to chemical problems of minor import and significance.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

June 12, 1875.

Professor Gladstone, F.R.S., President, in the Chair.

The Lord Lindsay, Sir W. Thomson, and Prof. Sylvester were elected members.

Mr. Wildman Whitehouse described some experiments he had made "*On the Electric Conductivity of Glass.*" He employed pieces of thermometer tube about an inch in length, into the bore of which two platinum wires were inserted in such a manner that there was an interval between the points. In some cases one wire of platinum occupied the entire bore of the tube, and the tube was surrounded on its external surface by a helix of wire of the same metal. In each case the arrangement was introduced into a circuit in which were also placed a Thomson galvanometer and a set of resistance coils. It was shown that at the ordinary temperature there was no deflection, but that the current passed freely when the glass was heated to redness. The difficulty of making contact with the glass led Mr. Whitehouse to use two test-tubes, one inside the other, both containing mercury with which wires of platinum freely communicated. The flame of a Bunsen burner was applied to the outer test-tube, and the temperature of the metal noted by the aid of a thermometer. In one series of experiments the diameter of the internal tube was $\frac{1}{4}$ inch, the length in contact with the mercury about $3\frac{1}{2}$ inches, and the thickness of the glass $\frac{1}{10}$th of an inch. A current was first observed to pass at 100° C., and, as the temperature rose, the amount of deflection increased. The following are approximate measurements of the resistance of the glass at different temperatures:—

	Ohmads.
At 165° C. resistance	249,500
,, 185 ,, ,, ...	100,000
,, 210 ,, ,, ...	69,000
,, 255 ,, ,, ...	22,500
,, 270 ,, ,, ...	9,000
,, 300 ,, ,, ...	6,800

Prof. Gladstone drew attention to the necessity for ascertaining the nature and composition of the glass.

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Prof. Guthrie alluded to the fact that electricity of high tension is freely conducted by glass at a red heat. He also asked whether, as the temperature was raised, a point was reached at which the conductivity began to decrease.

Prof. McLeod pointed out that most of the tubes in which the platinum wires were fixed were of lead-glass, and that the lead had in most cases been reduced by exposure to the flame employed and he urged that this fact should not be overlooked in measuring the resistances. He stated that lead-glass is better than other varieties of glass for insulation.

Prof. G. C. Foster asked whether an increased capacity due to the heating might not introduce an error into the measurements of resistance.

Mr. Whitehouse replied that he had only recently commenced the experiments, and promised that the suggestions which had been made should receive due attention.

The President then read a paper on "*The Time Required for Double Decomposition of Salts.* It is well known that if, on mixing solutions of two salts M R and M' R', an insoluble body can be produced by an interchange of metals and radicals, that body is produced to the fullest extent possible. The only explanation of this fact which has been given is founded on the theory of Berthollet, that in all cases of mixture there is a redistribution of the constituents according to their relative affinity and mass, with the production of more or less M R' and M' R. Now if one of these, say M R', be insoluble, it will remove itself at once from the sphere of action, but this will necessitate a fresh distribution of the constituents, with the production of more insoluble salt, and so on until the whole of the M has entered into combination with R'. Dr. Gladstone commenced this research twenty years ago, and stated in a note to a paper in the *Philosophical Transactions*—"It is easily conceivable that when the affinity for each other of the two substances that produce the insoluble compound is very weak, the action may last some time and become evident to our senses. Is not this actually the case when sulphate of lime in solution is added to nitrate of strontia, or carbonate of soda to chloride of calcium, or an alkaline carbonate to tartrate of yttria, or oxalate of ammonia to sulphate of magnesia, &c.?" The President gave several experimental illustrations of the time required for double decomposition. He showed that ferric chloride and sulphocyanide of potassium react instantly; that citrate of iron and meconic acid, chloride of platinum and iodide of potassium react gradually. The rate of change really depends on the degree of rapidity of the inter-diffusion of the salts. It is also affected to a very great extent by temperature. The following numbers illustrate the rate at which sulphate of strontium is deposited on the addition of sulphate of calcium to a solution of nitrate of strontium.

Cloud	..	in	4 minutes.
0·071 grms.		,,	20 ,,
0·130 ,,		,,	60 ,,
0·303 ,,		,,	110 ,,
0·497 ,,		,,	270 ,,
0·659 ,,		,,	1270 ,,

The total amount of salt which could be formed being 1·5 grms.

Quantitative Analysis of Cinnabar.—F. Gramp.—The author attacks cinnabar with nitric acid in a sealed tube, thus producing sulphuric acid, which is then determined as sulphate of baryta. The operation was perfectly and easily completed on heating the sample for two hours to 120° with nitric acid of specific gravity of 1·4. The nitric acid was then evaporated off, and the sulphuric acid thrown down with chloride of barium, after addition of hydrochloric acid. The excess of baryta is then removed with sulphuric acid, and the mercury precipitated with phosphorous acid, and weighed as calomel.—*Moniteur Scientifique.*

SOCIETY OF PUBLIC ANALYSTS.

ON THE MINIMUM OF SOLIDS IN MILK.

By J. CAMPBELL BROWN, D.Sc.,
Lecturer on Chemistry and Toxicology in the Liverpool Royal Infirmary School of Medicine.

The determination of the minimum—not the average—quantity of nutritive constituents in milk yielded by healthy cows is the necessary foundation of the standard by which adulterated milk may with certainty be judged. The milk yielded by cows in the large towns, where the cows are necessarily stall fed, is almost invariably much richer than that yielded by cows fed in the country. But the towns are always supplied, in part, with milk brought by rail or carts from the country; and as there are no means of analytically distinguishing with certainty between town and country milk, the country minimum must necessarily form the standard by which all milk, whose source is not absolutely known, must be judged.

Soon after the passing of the Adulteration Act of 1872, I obtained authentic samples of milk in Lancashire and Cheshire, which led me to adopt a standard slightly below that which has since been adopted by very many Analysts. I therefore think it desirable to place some of the details on record, not so much with the view of objecting to the standard so frequently acted upon as the basis for calculating the quantity of water added in the adulteration of milk, as of showing that this standard must be used with great caution in instituting prosecutions when the quantity of added water is small.

With regard to the method of analysis, I am perfectly satisfied with that described by Wanklyn, provided that 40 or 50 c.c. be taken for analysis, and that it be weighed, and the results be expressed in parts by weight. The dry residue should be kept in an air-bath at 99° C. for at least an hour before being weighed.

The following three samples are the poorest authentic samples out of three or four hundred which I have examined. In all cases the cows were properly milked under the inspection of persons on whom I can rely.

No. 1 is the mean of two concordant analyses of a sample of milk taken in November from a single cow fed with grass and grains; the property of a private gentleman. The cow had not calved for two years, and had nearly ceased giving milk.

No. 2 was milk taken in April, in the presence of a sergeant of police, from eight cows belonging to a farmer, who had been prosecuted, who knew three days before that a sample would be taken in presence of the police, and whose interest it strongly was so to feed his cows that they should yield as watery milk as possible on the day when the sample was to be taken. The milk was sealed up, and brought directly to me by the police.

No. 3 was milk taken in May from nine cows, in the presence of an inspector, at the request of a farmer.

	Total Solids.	Cream. Per Cent.	Fat.	Solids not Fat.
No. 1. ..	11·10	under 8	2·16	8·94
No. 2. ..	11·36	about 9	2·41	8·95
No. 3. ..	11·55	—	2·74	8·81

It appears, therefore, that 1 per cent of the milk yielded by healthy cows in Lancashire and Cheshire would be considered slightly adulterated if rigidly judged by the common standard; but that no sample from healthy cows, even under the most unfavourable circumstances, yielded less than 11 per cent total solids.

The following table, which is constructed on the supposition that the milk to which water has been added originally contained only the low minimum of 11 per cent total solids, will be found useful in readily stating the minimum amount of added water in adulterated milk. It may be read thus:—If analysis shows that a sample of milk contains a passable amount of cream, and the total

amount of solids found in the first column, then the sample contains less than the proportion of natural liquid constituents stated in the second column, and more than the proportion of added water stated in the third column; it is therefore adulterated by the addition of upwards of the amount of water stated in the fourth column to 100 parts of the poorest milk.

For instance, if analysis shows that a sample of milk contains 8·46 per cent of solid constituents, including, say, 1·8 per cent of fat, then it contains less than 68·47 per cent of the natural liquid of milk, and more than 23·07 per cent of added water. It is therefore adulterated by the addition of upwards of 30 parts of water to 100 parts of the poorest milk.

TABLE SHOWING THE ADULTERATION BY WATER OF MILK WHICH ORIGINALLY CONTAINED THE MINIMUM OF 11 PER CENT OF SOLIDS, INCLUDING FAT.

Percentage of Solids and Fat found by Analysis.	Maximum Percentage of Natural Liquid of Milk Present.	Minimum Percentage of Water from the Pump Present.	Minimum Quantity of Water Added as an Adulteration to every 100 parts of the Poorest Milk.
11·00	89·00	—	—
10·89	88·11	1·00	1·00
10·78	87·22	2·00	2·04
10·67	86·33	3·00	3·09
10·56	85·44	4·00	4·16
10·48	84·76	4·76	5·00
10·34	83·66	6·00	6·38
10·23	82·77	7·00	7·52
10·12	81·88	8·00	8·69
10·01	80·99	9·00	10·00
9·90	80·10	10·00	11·10
9·79	79·21	11·00	12·35
9·68	78·32	12·00	13·63
9·50	77·31	13·13	15·00
9·46	76·54	14·00	16·22
9·35	75·65	15·00	17·64
9·24	74·76	16·00	19·04
9·16	74·16	16·60	20·00
9·13	73·87	17·00	20·48
9·02	72·98	18·00	21·95
8·91	72·09	19·00	23·45
8·80	71·20	20·00	25·00
8·69	70·31	21·00	26·58
8·58	69·42	22·00	28·20
8·46	68·47	23·07	30·00
8·36	67·64	24·00	31·58
8·25	66·75	25·00	33·30
8·15	65·92	25·93	35·00
8·03	64·97	27·00	36·98
7·86	63·57	28·57	40·00
7·70	62·30	30·00	42·85
7·58	61·39	31·03	45·00
7·48	60·52	32·00	47·06
7·30	59·30	33·30	50·00
7·26	58·74	34·00	51·50
7·09	57·43	35·48	55·00
7·00	56·63	36·36	57·14
6·87	55·63	37·50	60·00
6·70	54·61	38·65	63·00
6·60	53·93	39·39	65·00
6·47	52·36	41·17	70·00
6·28	50·87	42·85	75·00
6·10	49·40	44·40	80·00
5·94	48·15	45·90	85·00
5·79	46·84	47·37	90·00
5·64	45·64	48·72	95·00
5·50	44·50	50·00	100·00
5·23	42·39	52·38	110·00
5·00	40·45	54·55	120·00
4·78	38·70	56·52	130·00
4·58	37·09	58·33	140·00
4·40	35·60	60·00	150·00
4·23	34·22	61·55	160·00
4·07	32·96	62·97	170·00
3·93	31·79	64·28	180·00
3·79	30·69	65·52	190·00
3·60	29·60	66·60	200·00
3·44	27·81	68·75	220·00
3·23	26·18	70·59	240·00
3·06	24·72	72·22	260·00
2·89	23·43	73·68	280·00
2·75	22·25	75·00	300·00
2·58	20·95	76·47	325·00
2·40	19·70	77·70	350·00
2·31	18·75	78·94	375·00
2·20	17·80	80·00	400·00
2·00	16·18	81·81	450·00
1·83	14·83	83·30	500·00
1·57	12·72	85·71	600·00
1·37	11·13	87·50	700·00
1·20	9·91	88·80	800·00
1·10	8·90	90·00	900·00
1·00	8·10	90·90	1000·00

"The Sale of Food and Drugs Bill," in a state virtually unaltered from that in which it was sent up by the Lower House, passed through Committee in the House of Lords on the 15th inst.

CORRESPONDENCE.

POLARISED LIGHT.

To the Editor of the Chemical News.

SIR,—The relations of polarised light to chemistry and physics are so intimate and interesting, that any novel application of it, even though not of apparent utility, may, I hope, be acceptable to your readers.

I would then very briefly draw attention to an adaptation which I made, about two years since, of this form of light to the well-known and beautiful optical instrument, the kaleidoscope, but which I have not before published.

This instrument, I need hardly observe, consists of a tube, within which are fixed at an angle representing an aliquot part of a circle, two or three plane mirrors, blackened on the outside, so as to give by repeated reflection symmetrical and constantly varying images of pieces of coloured glass or other transparent objects, placed in a cell at one end of the tube, the images being viewed through a small aperture at the opposite end.

Now it occurred to me, at the time referred to, that if pieces of selenite were substituted for the fragments of coloured glass, and polarised light were made to pass through the instrument, there would be seen, with the aid of an analyser, the beautiful colours given by that familiar double-refracting substance, reflected like those of ordinary light. Accordingly I selected films of selenite, presenting, when analysed, various colours corresponding with their respective thickness, and mounted them on pieces of thin crown glass of different shapes and sizes, placed them in the cell of a kaleidoscope, and adapted a tube to the other end so as to receive a second tube fitted with

small Nicol prism, or a tourmaline. I then found, as I had anticipated, that when light polarised by a plate of glass, or even by a cloudless sky, was transmitted through the cell, the reflected images of the selenite mountings were symmetrically and beautifully displayed.

To enlarge these polarised images, and to increase the strength of their colours by concentrating the rays, I have adapted in some of my instruments a lens of appropriate focus to the eye-end of the tube just below the Nicol, or analyser, but this addition is not in the least necessary.

Having referred to the polarised light of the sky, it may not be irrelevant to mention that not only in the bright azure of the morning it is beautifully displayed by my kaleidoscope, but even in the misty blue of the evening it is clearly and vividly revealed. At the present season, for instance, the colours given by the instrument may be seen in all their depth and beauty as late as half-past seven or eight o'clock in fine evenings. Indeed, the polarised images are in bright cloudless weather often brought out with greater intensity in the late evening than in the morning or afternoon. This fact appears, I think, to prove that the polarisation of the light of the sky is dependent upon aqueous vapour suspended in the atmosphere in a very fine state of condensation, and not, as Professor Tyndall supposes, upon some unknown body called by him "sky-matter."

Apologising for so far intruding upon your valuable columns.—I am, &c.,

W. H. Olley.

Stoke Newington, June 2, 1875.

THE ALUM TYPE.

To the Editor of the Chemical News.

Sir,—Will any one kindly inform as to the legitimacy or correctness of the two following isomorphous salts?—

$$Ag_2(Al)_2(SO_4)_4+24H_2O.$$
$$Ag_2(NH_4)_2(SO_4)_2+24H_2O.$$

The difference of character may, perhaps, be better seen by using the old notation—

$$AgO,SO_3+Al_2O_3,3SO_3-24HO.$$
$$(NH_4),SO_3+AgO,SO_3-24HO\ ?$$

As the silver-ammonium alum of M. Sergius Kern puzzles from a new monatomic point of view, so also does M. Roessler's indium-alum from a triatomic point of view.

With an evident clerical mistake in the notation, and no weights given, it is difficult to decipher the interesting novelty. If M. Roessler be correct, the indium weight should be 226·8, whereas, from another point of view, it should be 75·6 or 151·2!

Any information on these two alums would be very highly esteemed.—I am, &c.,

S. E. Phillips.

LEAD IN TINNED ARTICLES.

To the Editor of the Chemical News.

Sir,—In *Comptes Rendus* for September 12, 1874, M. Fordos states that he has found lead in the tinning of culinary vessels, and that there is a danger of poisoning by the action of dilute acids, such as vinegar, upon the lead.

English tin-plate also contains lead, likewise the *pure* block-tin pipe used by publicans in their beer-engines. It would seem, however, that, when the lead is present in only small quantity, the tin, being electro-positive, protects the lead during solution; for if a piece of the tin pipe be dissolved in HNO_3, and the liquid tested from time to time, only a faint yellow colouration is produced by H_2S, while, when the tin is completely oxidised, H_2S gives immediately a black precipitate.

Solder, however, does not act in this manner, presumably because it contains a very much larger quantity of lead.

It seems possible, therefore, that the presence of a small quantity of lead in tinned articles is not injurious.—I am, &c.,

A. P. S.

THE ACTION OF DILUTE MINERAL ACIDS ON BLEACHING-POWDER.

To the Editor of the Chemical News.

Sir,—Notwithstanding the discussions that arise from time to time on the constitution of bleaching-powder, I venture to think that any one acquainted intimately with the literature of the subject, can have no doubt that its nucleus is truthfully represented by the formula assigned to it by Odling. If a proof were wanted in spite of the previously existing vast analytical data, that proof was furnished by the isolation from bleaching-powder of calcic hypochlorite, in the manner described by me (*Journal of the Chemical Society*, series 2, vol xiii., p 404) at a recent meeting of the Chemical Society, when the crystallised body was exhibited.

I regret I could not stay to hear Mr. F. Kopfer's paper "On the Action of Dilute Mineral Acids on Bleaching-Powder" at the meeting of the Chemical Society on the 3rd inst., and will therefore venture to anticipate the publication of his paper in a measure by asking him to be good enough to point out the novel feature of his experiments. According to the abstract in your columns of the 11th inst., Mr. Kopfer found that pure hypochlorous acid free from chlorine was obtained by distilling a carefully prepared solution of bleaching-powder with dilute acids in the proportion sufficient to liberate only the hypochlorous acid, assuming the formula $Ca\begin{cases}Cl\\OCl\end{cases}$ to be correct. Gay-Lussac has long since shown that hypochlorous acid may be conveniently prepared in this manner (*Comptes Rendus*, xiv., 927) whilst if excess of acid be added chlorine is obtained.

Moreover, Schorlemmer in criticising a paper by Goepner (*Dingler's Polytech. Journ.*, ccix., 204), in a note read before the Manchester Literary and Philosophical Society, has pointed out the same facts; and states even that it is not only a lecture experiment at Owens College, but also an experiment which every student has to perform.

Further, W. Wolters (*Journ. Chem. Soc.*, series 2, vol. xiii., p. 422, from *Dingler's Polytech. Journ.*, ccxiv., 140 to 148) has described experiments in the same direction, at least, and which lead him to a similar view of the constitution of bleaching-powder.

In the face of these facts, I fail to see what is original in Mr. F. Kopfer's experiments; although, of course, the novel feature not being exhibited in the abstract alluded to, may be reserved for publication in the Chemical Society's *Journal*.—I am, &c.,

Charles T. Kingzett.

Kensington, W., June 12, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 20, May 24, 1875.

Dissociation of Methyl-Aniline Violet and its Separation into two Colours under the Influence of Certain Normal and Pathological Tissues, and in Particular by Tissues in a State of Amyloid Degeneration.—M. V. Cornil.—If certain tissues, whether normal or pathological, are stained with methyl-aniline

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violet, the latter is dissociated into two colours: a reddish and a blue violet. Each of these colours is fixed upon certain elements with remarkable constancy. The tone, the intensity, and the permanence of the colouration vary with the tissues examined, as well as with the strength of the solution employed.

Sulphuration of Copper and Iron after a Prolonged Immersion in the Hot Spring of Bourbon l'Archambault.—M. de Gouvenain.—An account of the spring in question, with its action upon Roman coins found lying in the water.

Certain Reactions of the Salts of Chrome.—M. A. Etard.—At present the reactions are not known by which the salts of sesquioxide of chrome can be converted instantly, and at will, from one modification to the other. The green salts only become violet under the influence of nitric acid after the expiration of a longer or shorter time. Certain reagents produce an immediate effect. The green salts become a carmine violet if mixed in the cold with a little nitrite of potash. The carmine tint developed at the moment of the mixture of the two solutions, and which resembles that of the amido-chromic compounds, gradually disappears to give place to the blue-violet which has chrome alum for its type. Sulphocyanide of potassium produces the same phenomena, but more slowly. The green solutions of chrome, if precipitated by potash, give a hydrate insoluble in ammonia, and which, if re-dissolved in acetic acid somewhat concentrated, takes a carmine-violet colour. In this case the carmine tint does not pass into the violet-blue in course of time. Under the influence of the arseniates, or of free arsenic acid, the violet salts become a bright green in a few seconds in the cold, and cannot be brought back to a violet by the nitrites. Nitrate of silver does not precipitate the arsenic acid of these salts. Lœwel admits four modifications of hydrate of chrome—two green, one violet-carmine, and one violet-blue. The violet-carmine salt obtained with a nitrite gives with potash a grey precipitate insoluble in ammonia, which distinguishes this salt from the ordinary one violet-blue salt. The light green salt obtained with the arseniates has the equally characteristic property of giving with potash a precipitate insoluble in acetic acid, and soluble in ammonia with a violet-blue—a reaction exactly opposite to that of the ordinary deep green salts.

The Camphenes.—M. J. Ribau.—An account of active lævo-gyratory camphene, of inactive α-camphene, of inactive β-camphene, and of Borneo camphene.

Reaction of Sulphide of Carbon: Transition of Sulphide of Carbon into Hydro-Sulpho-Cyanic Acid.—C. Saint-Pierre and G. Jeannel.—The authors find that sulphide of carbon in contact with ammonia, with nitrate of ammonia and potash, and with nitrate of ammonia and sulphide of potassium, gives rise to a characteristic production of sulphocyanide. In the discussion which followed, M. Dumas remarked that this reaction was well known to chemists, and had been utilised in the manufacture of ferrocyanides.

Moniteur Scientifique, du Dr. Quesneville, May, 1875.

Synthesis of the Derivatives of Anthraquinon by Means of Phthalic Acid, and the Derivatives of Benzin.—A. Bæyer and H. Caro.—A valuable paper, in which the chemical and physical attributes of erythroxanthraquinon and oxyanthraquinon are contrasted in a tabular form. It is remarked that all the bodies which when heated with sulphuric acid yield hydro-quinosulphonic acids furnish quinazarin when anhydrous phthalic acid is added to them. The remarkable procedure employed by Lalande, for transforming alizarin into purpurin, serves likewise for transforming quinizarin into purpurin by heating the former body to 140° with peroxide of manganese and sulphuric acid.

Amides of Diazo-Benzin.—A. Bæyer and C. Jäger.—Not adapted for abstraction.

History of Eosin.—M. A. Bæyer.—Eosin may be considered as tetra-bromated fluorescein. It is remarkable that tetra-brom-orcin-phthalein, a homologue of eosin, is colourless. If eosin is agitated at a gentle heat with water and sodium amalgam the liquid becomes colourless, because the bromine is removed, and colourless fluorescin is formed—the reduction-product of fluorescein. If the liquid is now diluted with water, and a few drops of permanganate are added, the oxidising action of this reagent at once transforms the fluorescin into fluorescein, and the colourless liquid becomes green and opaque by reflected light.

Dioxyquinon of Chrysen or Chrysezarin.—M. A. Claus.—Chrysezarin is found among the impurities of commercial alizarin to the extent of 3 to 4 grms. per kilo.

Facts Bearing on the History of Beech-Wood Tar. A. W. Hofmann.—The author shows that cœrulignon is indisputably the cedriret of Reichenbach, to whom the honour of the discovery therefore belongs.

On Cœrulignon.—A. W. Hofmann.—The composition of this body is—

Carbon	63·17
Hydrogen	5·27
Oxygen	31·56
	100·00

corresponding to the formula $C_{16}H_{16}O_6$.

Action of Concentrated Sulphuric Acid upon Cœrulignon and Hydro-Cœrulignon.—M. E. Fischer.—Cœrulignon dissolves in concentrated sulphuric acid with a blue colour, sulphurous acid being evolved. If the liquid is diluted with water it loses its blue tint and deposits a brown substance, which after a certain time takes a crystalline texture. The same body is obtained on diluting with water the fine red solution of hydro-cœrulignon in sulphuric acid.

Notice on the Camphor of Cubebs.—E. Schaer and G. Wyss.—Not suitable for abstraction.

Method for the Determination of Sulphur of General Applicability.—M. A. Sauer.—The author burns the material in a current of oxygen, and receives the sulphurous acid in hydrochloric acid containing bromine. The details cannot be given without the accompanying engravings.

Researches on the Simultaneous Diffusion of Certain Salts.—C. Marignac.—Reserved for insertion in full.

Fermentation and Putrefaction Considered from a Physiological Point of View.—M. Charles Blondeau.—A very lengthy paper, not adapted for abstraction.

Applications of Chrome in Calico-Printing.—M. A. Schultz.—This paper consists chiefly of practical receipts.

Chemical Products at the Vienna Exhibition.—M. E. Kopp.—(Continued.) The decolouration of blood-albumen for printing purposes, by means of ozonised air, is an interesting application.

Method and Tables for Polarimetric Assays of Beet-Root Juice.—M. E. Perrot.—The author takes 160 c.c. of juice, to which he adds 20 c.c. of a saturated solution of basic acetate of lead, and the same measure of a recent solution of tannin, containing 10 grms. per litre. The liquid is thus obtained perfectly colourless.

Bulletin de la Societe Chimique de Paris, No. 7, April 5, 1875.

Researches on the Fatty Acids and their Alkaline Salts.—M. Berthelot.—An examination of the amount of heat liberated during the formation of the fatty salts, both in the solid state and in solution.

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Anhydrous Acetic Acid.—M. Berthelot.—Already noticed.

Structural Formulæ in Space.—J. H. Van't Hoff.—An examination of the relation between asymetric carbon and active optical power, and between asymetric carbon and the number of isomers.

Correspondence from St. Petersburg.—M. W. Louguinine.—In the seventh volume of the *Journal of the Russian Chemical Society* M. Mendeleeff describes the deposits of spherosiderite at Kromy, in the Government of Orel. MM. Kamensky and Lund communicate analyses of the iron ores of Gytomir, which contain 59 per cent of metallic iron. M. Beketoff communicates, on behalf of M. A. Elketoff, a paper on the transformation of bromide of isobutyl into bromide of tertiary butyl under the influence of high temperatures. M. Beketoff, on behalf of himself and of M. Tscherny, communicates a note on the dissociation of suiphuretted, seleniuretted, and telluretted hydrogen; and, on behalf of M. Kousmensky, a note on the action of oxide of silver upon chloride, bromide, and iodide of lithium. M. Stcherbatscheff treats on the influence of the chloride of sodium on the dissociation of hydrated sulphate of soda in solution. M. Moun has examined the amount of coke yielded by three isomeric bodies—Swedish filter-paper, starch, and gum. The first, when submitted to destructive distillation, yields 6·73 per cent of carbonaceous residue; the second, 11·30; and the third, 20·4. M. Alexeeff gives a preliminary communication on the mutual solubility of liquids. The solubility of amylic alcohol in water decreases as the temperature increases, whilst the solubility of water in this alcohol augments under the same conditions. The second part contains an important investigation by M. Schöne on the peroxide of hydrogen contained in the atmosphere. M. Morkownikoft publishes a memoir on the oxidation-products of oxybutyric acid. M. N. Zalomanoff communicates experiments on a new method of determining the absorbent power of different soils. He proceeds by filtration, and concludes that the agitation method gives erroneous results. He cannot confirm Liebig's view that the drainage water represents the water in the soil. M. Beketoff publishes a note on the influence of the weight of elements on the reactions of substitution or double decomposition.

Progress of the Sulphuric Acid Manufacture in England.—M. G. Lunge.

No. 9, May 5, 1875.

Researches on the Carbon of White Cast-Iron.—MM. Schützenberger and A. Bourgeois.—Already noticed.

Unequal Action of Various Isomorphs on the Same Saturated Solution.—M. Lecoq de Boisbaubran.—Noticed elsewhere.

Substitution of Mercury for the Hydrogen of Creatin.—R. Engel.—Already noticed.

Stability of the Salts of the Fatty Acids in Presence of Water.—M. Berthelot.—Already noticed.

Les Mondes, Revue Hebdomadaire des Sciences.
No. 16, April 22, 1875.

This number contains no original chemical matter.

No. 17, April 29, 1875.

Electricity of Mineral Springs.—M. Thury.—Two platinum electrodes were plunged, the one in the great mineral spring of the Stadthof, and the other in the river Limmat. When connection was made the mineral water was found to be strongly electro-negative. If water was allowed to cool, and artificially re-heated, no current was produced.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 16, April, 1875.

This issue contains no chemical matter.

MISCELLANEOUS.

Organisation of the United States Board appointed to Test Iron, Steel, &c.—A Board has been appointed by the Government of the United States "to determine by actual tests the strength and value of iron, steel, and other metals which may be submitted to it, or by it procured, and to prepare tables which will exhibit the strength and value of said materials for constructive purposes." It has standing committees on abrasion and wear, on armour plate, on chemical research, on chains and wire ropes, on corrosion of metals, on the effects of temperature, on girders and columns, on metallic alloys, on physical phenomena, on steels produced by modern processes, &c. The constitution of this Board may be taken as an additional proof of the growing conviction how largely the power and the prosperity of nations depend on physical science.

Plattner's "Manual of Blowpipe Analysis."—Mr. D. Van Nostrand, the American publisher, writes:—I have just received from London what purports to be a translation of Plattner's "Blowpipe Analysis," which, upon examination, proves to be an exact reprint, word for word, of Prof. Cornwall's translation published by me. It is translated and edited, or purports to be, by T. Hugo Cookesley, and gives no credit to Prof. Cornwall, but merely says a translation has been published in New York, which he has followed to some extent. I have just issued the subjoined:—

NOTICE TO THE TRADE.—An English reprint of my edition of Plattner's "Manual of Qualitative and Quantitative Analysis with the Blowpipe" having appeared in London, I would hereby caution the trade against introducing the same into the United States, as under the copyright laws parties so doing would render themselves liable to legal damages, as well as to confiscation of all copies so imported and placed on the market. This English edition purports to be edited by one T. Hugo Cookesley, but with the exception of the omission of a few tables, and of some other matter of slight importance, it is a verbatim reprint of my edition, translated by Prof. H. B. Cornwall, of Princeton College. This "pirated" edition is published by Messrs. Chatto and Windus, of London.—D. VAN NOSTRAND, Publisher, New York, May 17.

The British Association Committee on Commercial Phosphates and Potash Salts.—No small amount of correspondence has appeared in our columns on the determination of phosphoric acid and on the discrepancies existing between the respective results of "high" and of "low" analysts. Our readers, doubtless, will be glad to find that steps are being taken towards the removal of a state of things discreditable to analytical chemistry and to its professors, and certainly injurious to an important and growing commerce. At the last meeting of the British Association, a committee, consisting of Messrs. E. Dewar, A. Fletcher, E. C. Stanford, and A. H. Allen, was appointed "for the purpose of examining and reporting upon the methods employed in the estimation of potash and phosphoric acid in commercial products, and on the mode of stating the results." Among other steps, the Committee have addressed a circular to all Fellows of the London Chemical Society, and, we hope, to other gentlemen engaged in, or conversant with, the analysis of manures, soliciting information. Among other questions, they ask—"Will you give the Committee the details of the process you habitually employ for the estimation of the phosphoric acid in commercial phosphates? What length of time does the process require? Are you of opinion that the method gives strictly accurate results? If not, will you state the direction in which the error occurs and its maximum extent?" If these and the succeeding questions meet with replies from experienced practitioners in this department, a body of most valuable information will be collected. After comparing the

answers, and bringing conflicting views, if such should appear, to an experimental test, the Committee will, we trust, be able to recommend for general adoption certain processes as suitable for different cases. Those chemists (if any) who feel unable to conform to such a decision will naturally be expected to state their "reason why." We hope that any of our readers who are in a position to throw any light upon this subject will communicate with the Secretary, Mr. A. H. Allen, No. 1, Surrey Street, Sheffield.

Programme de la Société Hollandaise des Sciences à Harlem, Année 1875.—We learn that the Council of the Society have made a donation of 2000 florins to the Netherlands Society for the encouragement of industry, to be applied in the purchase of objects for the Museum of Industrial Arts. The Société Hollandaise has also contributed towards the erection of monuments in honour of of two of its foreign members, Elie de Beaumont and Quetelet, and to the foundation of a Leeuwenhoek medal, to be awarded decennially for the most important microscopic researches on inferior beings. The following subjects have been proposed for prizes:—*For January 1st, 1877.*—(1). Complete account of the development, structure, and manner of life of the Ophioglossæ, as compared with the other ferns. (2). A historical and critical study, based upon personal observations and experiments, on the influence which light exerts on the vernal growth of plants. (3). As boats descend a river more rapidly than the water in which they are plunged, the question arises, what influence this circumstance has upon the vertical floats employed to measure the speed of the current. (4). An exhaustive study of the causes to which the luminous phenomena of phosphorescent minerals are due. (5). The extent in the Netherlands of the fossiliferous stratum known as the Eemian system (of Harting), accompanied by a collection of its animal and vegetable fossils and an account of its relations with other known deposits. (6). A methodical study of the influence of stretched cords upon the acoustic properties of halls. *On January 1st, 1880.*—(7). What is the influence of the moon upon the position of the magnetic needle? Essays on the following subjects must be sent in by *January 1st, 1876*:—(8). Exact researches on the solvent power of water and of water charged with carbonic acid upon gypsum, limestone, and dolomite at various pressures and temperatures, and in the case of the simultaneous presence of common salt and of other soluble salts widely distributed in nature. (9). A similar set of researches upon silica and natural silicates. (10). A critical examination of researches on the peptones of different albumenoid matters completed by original investigations. (11). An exact determination, in Weber's units, of the resistance of a column of mercury of a metre in length and a square millimetre in section. (12). An experimental investigation of the relation between electromagnetic and electro-static unities. (13). New experiments on the influence of pressure upon chemical action. The memoirs may be drawn up in Dutch, French, Latin, English, Italian, or German, but must not be written in German characters—a very wise precaution. We cannot help remarking that we have little faith in the efficacy of prizes offered to stimulate research. It has been humourously said that you cannot bribe a barren hen to lay eggs. The rewards proposed should, at any rate, amount to a fair remuneration for the time that the required investigations must necessarily engross, but of this they fall lamentably short.

Paton and Harris's Pyroletor, for the Extinction of Fire on Board Ships.—Under the supervision of Dr. R. Carter Moffat, who conducted the experiments, a large party of gentlemen connected with shipping and the Board of Trade assembled at Greenhithe, near Gravesend, on Tuesday, to witness the power of the pyroletor to extinguish fire in closed places. The pyroletor consists of a small double pump worked by hand, which sucks up from tubes on either side of it strong muriatic acid and a solution of bicarbonate of soda, which commingle in a generator forming part of the pump, and the carbonic acid gas and solution of salt pass at once down a metal pipe to the hold, along whose keelson runs a perforated wooden box which admits of the gas passing through to the burning material. The agent, therefore, for the extinction of fire is dry carbonic acid gas, which has no action on cargo. A well-appointed steamer conveyed the party from Blackwall to Greenhithe, where a large wooden barge had been prepared for the experiments. Its entire hold was covered to a depth of several feet with wood shavings, cotton-waste saturated with turpentine, and naphtha. A temporarily-raised and by no means air-tight wooden deck, with loosely-fitting boards, formed the wide hatchway covering. After the apparatus had been explained by Dr. Moffat, its action as a common wash-deck-pump and fire-engine for fire above board had been observed, when it acted very efficiently, throwing water a distance of at least 30 feet, the pipes to the chemicals were attached, and the signal given to set fire to the inflammable materials in the hold. Immediately the flames ran along the entire cargo and issued above the temporary deck, which was then covered with boarding. The pyroletor having been brought into action, and although nearly half a gale of wind was blowing, the fire was completely extinguished in four minutes. The experiments were so completely successful, and the efficiency of the apparatus so apparent, that the party at once agreed to sign a memorial to ask Government to compel all long-passage ships conveying passengers and cargo to carry one of these instruments. It is computed that a 1200-ton ship requires about half-a-ton of each of the chemicals, which, with their packages, cost about £20

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

A new method of producing heat. Carl Julius Tetens Hanssen, Chancery Lane, Middlesex. August 8, 1874.—No. 2749. Producing heat by burning gases containing hydrogen in carbonic acid gas at a high temperature, with a small addition of air or oxygen.

Improvements in and improved appliances and arrangement of apparatus for the manufacture and concentration of sulphuric acid. Auguste Ferdinand De Hemptinne, chemist, Molenbeek, Saint Jean, Brussels. August 14, 1874.—No. 2807. This invention describes a method of manufacturing and concentrating sulphuric acid by reducing the size of the leaden chambers ordinarily employed, but increasing their surfaces by filling them with stoneware vessels, by sprinkling these vessels with the acid in process of manufacture; also a modification of the Gay-Lussac tower for denitrification and concentration by superheated steam acting on porcelain vessels over which the acid is trickling, and kept away from contact with the walls of the chamber.

Improvements in treating metals and their alloys by subjecting them to the action of liquids, gases, vapours, and in apparatus employed therein, and for the manufacture of gas for illuminating and heating purposes. Wade Hampton Smith, civil engineer, Edgbaston, Birmingham, Warwick. August 15, 1874.—No. 2815. The inventor uses wood-naphtha, hydrocarbon, hydrochloric acid, nitrous acid, nitric acid, and iodine in a fluid state, and the gases and vapours resulting from any or all of the above liquid matters, carburetted hydrogen or coal-gas, nitrogen-gas, and atmospheric air in such proportions as may be required, combined or uncombined. In carrying out the improvements, each of the before-named fluids are placed in separate vessels or chambers; the contents of these respective chambers are capable of being conducted and are conducted together or separately into a passage through which a current of atmospheric air, gas, or vapour is caused to flow, so that the atmospheric air, gas, or vapour alone or combined with any or all of these liquids, gases, or vapours may be conducted in any required proportions to the cupolas, furnace, converter, or other suitable vessel containing the metal or metals to be acted upon, or to a receiver or gasometer for further use, or when required for illuminating and heating purposes. The principle adopted and the apparatus used for effecting the above are the same or similar to that well known for making ether sprays or other air spray jets. The gases or vapours are described in Specification of Letters Patent granted to the inventor and J. T. Kirkwood, dated February 18, 1874, may be used and applied to operate in like manner on the metals above mentioned and their alloys.

Improvements in the manufacture of light gases, and in the method of inflating balloons therewith (for military and other purposes), and in machinery and apparatus for such purposes, and for directing, guiding, propelling, and managing such balloons. Isham Baggs, practical chemist, High Holborn, Middlesex. August 15, 1874.—No. 2821. This invention consists, first, in the manufacture of light gases for the inflation of balloons, such gases being hydrogen gas obtained by the action of hydrochloric acid or sulphuric acid upon zinc; or th light gases produced by the combustion of wood, straw, or other materials, and in machinery and apparatus employed for such purposes

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and, secondly, in machinery and apparatus consisting of wings and a tail, which can be placed at different angles and in different positions, so as to direct and control the movements of the balloon.

Improvements in the manufacture of cement. Granville Hamilton Forbes, Clerk in Holy Orders, Broughton Rectory, Northampton. August 15, 1874.—No. 2822. My present invention is an improvement upon the invention for which I made application for Letters Patent July 7, 1874.—No. 2374. According to the said former invention I intimately combine coke or its equivalent with chalk and clay with or without tar, for the purposes of manufacturing cement. According to my present invention I intimately combine coke, or coke-breeze, or an equivalent of the same, or coal or coal dust with chalk, or limestone, or quicklime, with or without tar for the purpose of manufacturing cement.

Improvements in the treatment of alizarin for the production of different colours or hues therefrom in dyeing and printing. Félix De Lalande, civil engineer, Rue d'Enfer, Paris. August 18, 1874.—No. 2841. This invention consists in treating alizarin with various oxidising agents in order to obtain therefrom colours or hues in dyeing and printing differing from those obtained from alizarin without such treatment. One method of operating consists in mixing together dried and pulverised alizarin, arsenic acid, and sulphuric acid in given proportions; heating the compound; and boiling the same with water, after which it is filtered and washed. In place of the arsenic acid, antimonic acid, or peroxide of manganese, or stannic acid may be employed. According to another method dried pulverised alizarin is mixed with concentrated nitric acid, refrigerated by means of ice, and after a few minutes the mass is poured into cold water, and the precipitate is collected and washed. According to another method the alizarin suspended in water is treated with bichromate of potash or peroxide of lead, nitrate of copper, nitrate of mercury, mercurous nitrate, perchloride of iron, sulphate of peroxide of iron, or nitrate of peroxide of iron. According to another method alizarin-paste is mixed with sulphate of copper, chlorate of potash, and siliceous sand; the mixture is heated in a vapour-stove for several days, and is then treated with water to remove the soluble salts, and the colouring matter is extracted by caustic soda, and precipitated by an acid.

Improvements in the treatment or manufacture of cast-iron. George Gordon de Luna Byron, Chancery Lane, Middlesex. August 22, 1874.—No. 2883. This consists in alloying cast iron while in a molten state with copper, tin, zinc, manganese, and antimony. This flux is melted in a crucible, and mixed with iron, whereby the oxides, sulphur, and phosphorus are removed, and reducing the carbon therein.

Improved disinfecting or fumigating candles and pastiles. Frank Wirth, of the firm of Wirth and Co., Frankfort-on-the-Main, Germany. (A communication from William Ressig, Ph.D., Darmstadt, Germany.) August 22, 1874.—No. 2884. The object of this invention is to obtain candles and pastiles which when ignited give off a continuous current of sulphurous acid gas for disinfecting and fumigating purposes.

A new and improved process for the manufacture of sulphur-acids, and of sulphites, bisulphates, and sulphates. Alfred Payne, manufacturing chemist, Wolverhampton, Stafford. August 24, 1874.—No. 2893. The inventor burns sulphur or sulphur-ores in a close kiln, admitting only sufficient air for the proper combustion of the sulphur. He inserts one or more pipes into the crown of the kiln, which (after traversing suitable refrigerators) are attached to one or more force-pumps, by which the sulphurous acid fumes are drawn off from the kiln as fast as generated, and forced or projected through one or more outlet-pipes into the vessels containing the material to be operated upon. He produces sulphites and bisulphites directly in this way, and thus avoids the use of sulphuric acid in their production. The inventor produces sulphuric acid by oxidating liquid sulphurous acid (formed by injecting sulphurous fumes into water) by means of nitric acid or other suitable oxidating agents. The inventor produces sulphates by first forming sulphites by the before-mentioned process, and then oxidating by agitation with atmospheric air, or by means of other suitable oxidating agents.

An improved white metallic alloy. Louis Victor Léniau, merchant, Place de la Bourse, Paris. August 29, 1874.—No. 2954. This Provisional Specification describes a white alloy composed of copper, nickel, bismuth, zinc, malleable iron, and tin.

Improvements in the manufacture of sulphate of soda and of sulphate of potash. Arthur McDougall, manufacturing chemist, of the firm of McDougall Brothers, Manchester and London. September, 2, 1874.—No. 3003. In the manufacture of sulphate of soda and of sulphate of potash by the direct action of sulphurous acid upon the chlorides of sodium and of potassium, great expense and trouble is caused by the usual process of moulding and breaking the moulded salt into lumps, so that when placed in the saturation-cylinders a free passage is allowed for sulphurous acid gas. My invention consists in maintaining the salt in motion whilst exposed to the action of the sulphurous acid gas by the use of suitable mechanical means, so that the salt may be employed in a loose state, and thus save the trouble and expense of preparing lumps, and also cause a more rapid completion of the decomposing action. I also introduce steam in a superheated state during the process; by this means a more rapid action takes place, and the necessary temperature is more easily kept up.

Improvements in apparatus for the manufacture of sulphate of soda and sulphate of potash. William Hunt, manufacturing chemist, Castleford, near Normanton, York. September 2, 1874.—No. 3005. This invention has reference to that process of manufacturing sulphate of soda and sulphate of potash, in which chloride of sodium or chloride of potassium is decomposed by a mixture of sulphurous acid gas, air, and steam; and the said invention consists in erecting the chambers in which the chloride is decomposed immediately over the pyrites burners. The hot gases from these burners pass out through the arches of the burners, and travel under and in contact with the floors of the chambers. By this invention the bottoms of the chambers are maintained at a high temperature, which is communicated to the gaseous mixture as it circulates through the chambers, and the requisite high temperature is preserved.

Improvements in the manufacture of stearine, with the object of transforming oleines or oleic acids into crystalline substances, which may be employed either to make candles or soap, or for other purposes; and for extracting the solid matter that the oleic acids contain in solution, and thus to render them more limpid. William Morgan-Brown, of the firm of Brandon and Morgan-Brown, engineers and patent agents, Southampton Buildings, London. (A communication from Edward Bastie, chemist, Rue Gaillon, Paris.) September 3, 1874.—No. 3021. This invention describes a method of transforming oleine or oleic acids into elaidine or elaidic acid by putting these bodies in intimate contact with reagents which produce the reduction of any peroxide or any hydrogenic acid, with allotropic or nascent hydrogen, or any decomposition, chemical or electric, of water made by chlorine or other substances.

Improvements connected with the process of coating steel, iron, and cast-iron with gold, silver, and other metals or alloys. Jacob Baynes Thompson, Whitehall, Wraysbury, Bucks. September 4, 1874.—No. 3033. The invention consists in protecting the articles to be coated on their passage from the "cleaning-vat" to the "plating-vat" by applying thereto a thin film of aluminium or aluminium slightly alloyed.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Magnesite and Bauxite.—Can any of your subscribers inform me where I can obtain magnesite and bauxite, as I wish to possess some of these materials?—S. E. G.

Fish Oils.—I desire practical directions for testing the purity of the most common fish oils. Can any of your readers kindly refer me to some publication where I may find such?—G. C.

Analysis of Sugar.—Could any of your readers inform me where I could see an account, in English, of Dr. C. Scheibler's new process for the valuation of raw sugar by the use of alcohol? By giving the above information they would greatly oblige.—J. W. M.

Phosphorescent Powders.—Will your readers kindly furnish me with answers to the following questions?—(1) What is the composition of the phosphorescent powders of various colours advertised in your columns? (2) What is the cause of the phosphorescence which these powders assume for a short time after their exposure to light? I am not aware that the powders are patented. They smell strongly of sulphur.—A. F. S.

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THE CHEMICAL NEWS.

VOL. XXXI. No. 813.

NOTE ON SOME CRYSTALLINE PRODUCTS OBTAINED FROM A BLOWN-OUT IRON FURNACE.

By GEORGE JOHNSTON, F.C.S.,
Student in the Yorkshire College of Science, Leeds.

On recently blasting out, in the Middlesborough district, the mass of metal, slag, &c., which gradually collects beneath an iron furnace, and is technically known as the "dead-horse," a quantity of bright crystalline matter was found immediately below where the hearth had been when the furnace was in operation. The crystals belong to the octahedral system, are light grey in colour, and of various sizes, some of them being very large. It is almost certain that the mass of slag, &c., with which they were associated has been for ten or twelve years continuously at a temperature not much below that of the melting-point of cast-iron. They are apparently homogeneous, but may readily be separated under the pestle into a dark coloured, easily pulverised, and comparatively lustreless portion, and into little irregular masses, which are malleable, and when beaten out light coloured and highly lustrous. This malleable portion forms one-third of the larger crystals, and nearly two-fifths of the smaller. It is tolerably uniform in composition as the following analysis made on portions (No. 1, obtained from a large crystal of sp. gr. 5·48, and No. 2, from a small one, sp. gr. 4·89) will show:—

	No. 1.	No. 2.
Iron	95·69	94·48
Graphite	1·62	3·52
Combined carbon	0·94	0·10
Silicon	1·56	1·54
Phosphorus	0·18	0·36
Sulphur	0·21	0·10
Manganese	trace	none
	100·20	100·10

The composition of the easily pulverised portion of one crystal bears no relation to that of another. An analysis* of this portion of the above-mentioned crystals gave the following results:—

	No. 1.	No. 2.
Iron	82·66	65·59
Graphite	11·64	29·58
Combined carbon	2·89	1·43
Silicon	0·93	2·27
Phosphorus	0·27	0·68
Sulphur	0·18	0·39
Manganese	1·44	0·24
	100·01	100·18

The composition of the crystals as a whole calculated from the analysis of its two constituents is as follows:—

	No. 1.	No. 2.
Specific gravity	5·480	4·892
Iron	87·00	76·62
Graphite	8·30	19·62
Combined carbon	2·24	0·92
Silicon	1·14	1·99
Phosphorus	0·24	0·55
Sulphur	0·19	0·27
Manganese	0·96	0·14
	100·07	100·11

* The determinations of the carbon in these powders were made by Wöhler's method, that is, burning in a stream of oxygen; experiment showed that it was impossible to effect the complete oxidation of such large quantities of graphite by the chromic acid method.

Titanium was carefully tested for without obtaining any indication of its presence.

In addition to the crystals large quantities of a lustrous laminar substance were discovered in the "horse." This laminar mass contains a very high percentage of graphite and of silica; over 40 per cent graphite, and nearly 30 silica. The rest consists chiefly of a mixture of metallic iron, sulphide, and oxide, of which the oxide is much the larger constituent.

The production of these substances in the "dead-horse" from the original cast-iron which had found its way there from the furnace, may be explained by supposing that as this iron gradually cooled, the carbon has separated out in the form of graphite, ascended through the mass of metal, slag, &c., and thus become concentrated in the upper layers, much in the same manner as it is sometimes found on the surface of slowly cooled iron. The conditions existing in the "horse" would be greatly more favourable for such a separation than when the iron is exposed, owing to the extremely slow rate at which the mass cools. The highest part of the "horse" would, according to this view, contain the largest percentage of graphite, and as we descended this would become more and more mixed with iron, giving rise, indeed, to products similar to those now before us.

The octahedral character of the crystalline mass is evidently due to the iron, which, under the favourable conditions of a prolonged exposure to an intensely high temperature and a subsequent slow cooling, has assumed its normal crystalline form notwithstanding the large quantity of graphite with which it was mixed.

My thanks are due to Professor Thorpe, to whom the specimens were originally sent, for his advice and assistance; and to Dr. Parkinson of Bradford, from whom they were received, for information concerning the circumstances under which they were found.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from page 264).

Th. Graham, who, in his classical researches, investigated the laws of the escape of gases through narrow apertures, made known in 1866† that air which is drawn through a fine chink in a plate of caoutchouc passes in the constant proportion of 41·6 per cent of oxygen to 58·4 per cent of nitrogen, the half of the atmospheric nitrogen being held back. This mixture causes glowing chips of wood to burst into flame. Deville‡ tested the industrial value of this process, and found that the time required was too long.

Absorption has been utilised in two distinct forms. Montmagnon and De Laire in 1868 took out a French patent,‖ based upon the observation of Angus Smith§ that charcoal absorbs from the air more oxygen than nitrogen. According to them, 100 litres of wood-charcoal absorb 925 litres of oxygen, and only 750 litres of nitrogen. If moistened with water, they give off 350 litres of oxygen and 650 litres of nitrogen, so that 575 litres of oxygen and 55 (100?) litres of nitrogen remain and can be extracted with the air-pump. By repeating this process with the same gaseous mixture, they succeeded in bringing the oxygen almost in a state of purity. Whether this process has ever been carried out on the large scale is not known. An attempt has, however, been made with Mallet's

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."
† Graham, *Comptes Rendus*, lxiii., 471.
‡ Deville, Wagner, *Jahresberichte*, 1867, 216.
‖ *Bull. de la Soc. Chim.* [2], xi., 261.
§ Angus Smith, *Proc. Roy. Soc.*, xii., 424.

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method,* based on the property of water to absorb oxygen rather than nitrogen.

The coefficients of absorption of the two gases are 0·025 for N, and 0·046 for O. If multiplied by the proportion of their bulk in the atmosphere, 0·79 for N, and 0·21 for O, these numbers give the volume-proportion of both gases in water = 0·0197 N and 0·0097 O; or, the air absorbed in water contains, in one volume, 0·67 N and 0·33 O. If the unabsorbed nitrogen is allowed to escape, and the absorbed gaseous mixture, richer in oxygen, is withdrawn from the water and again absorbed, it follows, from the multiplication of the two coefficients of absorption with the volume proportions 0·67 N and 0·33 O, that the gaseous mixture now taken up has the composition 0·525 N : 0·475 O; a third absorption raises the result to 0·375 N : 0·625 O; a fourth to 0·25 N : 0·75 O; and a fifth to 0·15 N : 0·85 O, the proportion in which the two gases occur in Tessié du Motay's oxygenous mixture. After the eighth absorption, the gas is almost pure oxygen (0·973 O and 0·027 N).

Mallet's apparatus consisted of a larger or smaller number of strong iron water-holders connected with each other by means of suction- and forcing-pumps. Into the first air is driven through fine apertures at a pressure of about five atmospheres. The unabsorbed nitrogen escapes by a valve. The absorbed gas is now extracted by the second pump from the first receiver and forced into the second. With a series of four receivers the operation lasts five minutes. If the receivers serially decrease in size, the first holding 10 cubic metres and the last 5, the result of a continuous working of the process is 7760 litres per hour of a gaseous mixture containing 75 per cent of oxygen, or 168 cubic metres in twenty-four hours. The cost of working, wear and tear, and supervision are said to be insignificant. Where motive power is cheap, *i.e.*, water-power or the waste heat of metallurgical processes, this method may consequently be applicable, especially for use in such metallurgical operations where a mixture comparatively poor in oxygen is serviceable.

If we sum up the results of our survey of the methods for the industrial preparation of oxygen, we must place Tessié du Motay's process in the first line, as well tried and proved, and in the second Mallet's mechanical process as just described.

Finally, we pass to the question, To what applications has oxygen hitherto been put? As the supporter of combustion, we owe to it heat and light; and as the medium of respiration, it is the condition of life.

(To be continued.)

ANALYSIS OF MUD, TAKEN AT LOW WATER, FROM THE MER-ROUGE, MAURITIUS.

By C. J. H. WARDEN,
Surgeon, 26th Bengal Native Infantry.

ONE hundred parts of the soil dried at 242° F. contained—

Ferric oxide	25·634
Aluminic oxide	14·037
Calcic oxide	3·425
Magnesic oxide	1·353
Sodic oxide	0·627
Silicic anhydride	40·782
Phosphoric anhydride	0·893
Sulphuric anhydride	0·362
Carbonic anhydride	2·526
Chlorine	0·968
Organic matter	9·711
	100·318

Malarious fevers have been attributed to the emanations from this soil. The amount of ferric oxide is large, but otherwise there is nothing peculiar in its chemical composition.

* Mallet, *Dingler's Polyt. Journ.*, cic., 112.

ON THE ESTIMATION OF PHOSPHORIC ACID AS AMMONIO-MAGNESIAN PHOSPHATE.

By THOMAS ROBERTSON OGILVIE.

ALTHOUGH this process is one of the most important and most frequently used methods in the whole field of analysis, a very considerable number of directly contradictory statements regarding the precautions to be observed in its manipulation have been published during the last few years by chemists in this country and elsewhere. For instance, several authorities state that the precipitation of the ammonio-magnesian phosphate should take place in a cold solution. Watts, in his "Dictionary," says (vol. iv., p. 543), "Care must be taken not to allow the liquid to become very hot, as in that case hydrate of magnesium will be precipitated, and will be very difficult to re-dissolve." Schumann, quite recently (*J. pr. Chem.* [2], vi., 416), makes a similar statement; and Brunner (*Zeitschr. Anal. Chem.*, xi., 30—32) gives the results of two analyses of a bone-ash, showing that the one done at 60—70° C. was 1·25 per cent of P_2O_5 higher than the other done at 20° C. On the other hand, Parnell (CHEM. NEWS, vol. xxiii., p. 145) recommends precipitation in a warm solution: he says—"In order to insure the purity of the precipitate I now raise the two ammoniacal solutions to the boiling-point; on mixing them and stirring, a bright crystalline precipitate appears, which so far has never failed to be pure." Munroe also (CHEM. NEWS, vol. xxiv., p. 32) prescribes the same means as a precaution by which to get a precipitate of the greatest purity.

Another matter on which differences of views exist is the influence of citric acid. In a valuable paper written by Fresenius, Bauer, and Luck (*Zeit. f. Anal. Chem.*, vol. x., p. 133), the statement is made that magnesium citrate is often precipitated with the phosphate, while Warington, who originally proposed the adoption of citric acid instead of tartaric acid, asserts (*Journal of the Chemical Society*, vol. x., p. 326) that he "never obtained any precipitate by treating magnesia mixture with citric acid, though varied conditions have been tried." Again, Fresenius and others give as a process for the estimation of phosphoric acid in combination with alumina, the addition of sufficient citric acid to hold up the oxide and the precipitation of the acid as ammonio-magnesian phosphate. Well, the explicit statement is made by Knap (*Zeitsch. f. Chemie*, vol. ii., p. 157) that he found the presence of alumina rendered the estimation of phosphoric acid impossible by this process, as, even after allowing the solution to stand for some time, no precipitate was found.

A further point of dispute is the value of re-dissolving and re-precipitating the precipitate as a means of freeing it from impurity. In the text-books this precaution is recommended: and recently Kubel (*Zeit. f. Anal. Chem.*, vol. viii., p. 125) asserted that as the weight of the pyrophosphate is invariably too high, the ammonio-magnesian phosphate should be re-dissolved and re-precipitated at least once. Heintz says (*Zeit. f. Anal. Chem.*, vol. ix., p. 16) the error arising from the co-precipitation of magnesium hydrate or of neutral or basic magnesium sulphate can be corrected by once more re-dissolving and re-precipitating. On the other hand, Schumann (*J. pr. Chem.* [2], vol. vi., p. 416) considers it unnecessary to re-precipitate if the addition of a great excess of magnesia solution is avoided; while Parnell (CHEM. NEWS, vol. xxiii., p. 145) states that he sometimes found the ignited precipitate to contain an excess of magnesia to the extent of 8 per cent, and in such cases re-solution in hydrochloric acid and re-precipitation with ammonia failed to give a pure precipitate.

I might go on to quote further conflicting statements regarding the other details of this process, but I think I have brought forward sufficient to show that there is great necessity for investigation as to the exact and specific

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modus operandi that should be observed in its manipulation. And need we be astonished at the discrepancies in the commercial analyses of phosphates—many of which are done by this method—in the face of such great disparity in the views and results arising from scientific investigations? These discrepancies are proverbial, and the efforts of some of the dealers in phosphatic materials to get agreeing results from different analysts would be amusing were they not so suggestive of irritation to the merchants and of discredit to the analysts.

The following are the details of a series of experiments that were made with the intention of gaining some knowledge of the influence of certain reagents on the purity of the ammonio-magnesian phosphate, and also with the hope of ascertaining the best conditions otherwise under which this process should be performed:—

The "magnesia-mixture" employed contained in 1 c.c.—

0·0613 grm. magnesium chloride;
0·1401 ,, ammonium chloride;
0·0191 ,, ammonia (NH_3).

The solution in which the phosphoric acid was estimated was one of hydro-disodic phosphate, containing 0·2021 P_2O_5 in 50 c.c., equal to 0·3160 pyrophosphate of magnesia. 4·42 c.c. of the "magnesia-mixture" therefore precipitated exactly this quantity of phosphoric acid:—

5 c.c. allowed an excess of about 14 per cent of magnesia;
7 c.c. allowed an excess of about 50 per cent of magnesia;
13·5 c.c. fully twice more than necessary; and
20 c.c. three and a half times more than necessary.

All the precipitations were made at the ordinary temperature (unless when otherwise specified) and in solutions of about 100 c.c. in volume. Six hours were allowed for each precipitation. The reagents were free from all impurity, and the ammonio-magnesian phosphate was in each case washed until no chlorine was found in the filtrate with nitric acid and argentic nitrate. The precipitate was dried at 100° C., carefully separated from the filter-paper, the filter-paper placed in a porcelain crucible and thoroughly incinerated, then the precipitate also transferred to the same, slowly heated over an argand to drive off water of hydration and ammonium hydrate, and then placed over a Bunsen and ignited till of constant weight. The results are given as pyrophosphate of magnesia; the quantity which should have been got in each experiment was 0·3160 grm.

A.—*Precipitation of P_2O_5 in Presence of Varying Proportions of Magnesia-Mixture.*

No. of Expt.	Mg. Mix.	(a) $2MgO,P_2O_5$.	(b) $2MgO,P_2O_5$.
1	5 c.c.	0·3160 grm.	0·3160 grm.
2	7 ,,	0·3150 ,,	0·3200 ,,
3	13·5 ,,	0·3190 ,,	0·3335 ,,
4	20 ,,	0·3220 ,,	0·3280 ,,

In (*a*) the "magnesia-mixture" just described, and which contained the base as chloride, was employed; in (*b*) the mixture contained the same proportion of magnesia as that used in (*a*), but in the form of sulphate. In 1 and 2 (*a*) the theoretical result was obtained, although in the latter an excess of 50 per cent of magnesia was present. In 1 of (*b*) the same result was obtained, while in all the others high results were got, owing to the precipitation of a magnesium compound other than the phosphate. I have not tried if the addition of a proportionately increased quantity of ammonium chloride would give purer precipitates. I believe it would. These details indicate, however, that the best results are obtained when the mixture contains the magnesia as chloride, and when not more than 50 per cent of an excess is added.

B.—*Precipitation of P_2O_5 in Presence of Varying Quantities of Ammonium Chloride and of Magnesia-Mixture.*

No. of Expt.	NH_4Cl.	Mg. Mix. = 5 c.c.	Mg. Mix. = 7 c.c.
1	0·25 grm.	0·3155 $2MgO,P_2O_5$	0·3160 $2MgO,P_2O_5$
2	0·50 ,,	0·3150 ,,	0·3150 ,,
3	1·00 ,,	0·3150 ,,	0·3160 ,,
4	1·50 ,,	0·3150 ,,	0·3150 ,,
5	2·00 ,,	0·3150 ,,	0·3140 ,,
6	2·50 ,,	0·3155 ,,	0·3140 ,,

By the use of hydrochloric acid in dissolving a superphosphate or a mineral phosphate, a certain proportion of ammonium chloride is introduced into the solution in which the P_2O_5 is precipitated; but these experiments show that this salt has practically no influence, at least if present in only moderate quantity.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

June 17, 1875.

Professor ABEL, F.R.S., President, in the Chair.

AFTER the names of the visitors had been announced, and the minutes of the previous meeting read and confirmed, Messrs. R. E. Cumington, C. T. Blanshard, H. H. Hastings, and R. Stellon were formally admitted Fellows of the Society. The names read for the first time were those of Messrs. J. A. P. Price, B.A., A. S. T. McDonald, A. M. Graham, and W. Davis. For the third time—Messrs. Ludwik Bernstein, George Williams Wigner, John Macdonald Cameron, George Archbold, and Ralph Waldo Emerson MacIvor, who were balloted for and duly elected.

Mr. R. WARINGTON gave a short summary of his elaborate and valuable "*Notes on the Chemistry of Tartaric and Citric Acids.*" After touching on the preparation of the standard acids and alkalies and the extremely delicate litmus-paper employed in the titrations, he stated that he had found that the crystallised citric acid, as prepared in Mr. Lawes's manufactory, invariably contained one molecule of water which it lost in the water-bath, but not always *in vacuo* over sulphuric acid, for, strange to say, he had noticed that, in some instances, the acid did not lose weight under these circumstances. Citric acid was now made almost entirely from lemon-juice prepared from the windfalls and imperfect fruit. In its unconcentrated state it contained 8—9 ozs. of acid per gallon, whilst that expressed from the fruit imported into England contained 10½—12½ ozs. There was usually about 64 ozs. of free citric acid per gallon in the concentrated juice and 6 or 7 combined with bases; of the total acid about 8 per cent was not citric acid. Details were given of the methods of analysis employed for the estimation in the citric acid liquor of the free sulphuric acid, the total organic acids, and the actual citric acid. In treating of tartaric acid the author, after noticing the fact that tartaric acid can never be fused without the production of ditartaric acid, and the effects of various salts and acids on the solubility of potassium bitartrate, explained what "lees," argol, and tartar were. The lees which are deposited at the bottom of the cask vary in the amount of tartaric acid which they contain in the state of potassium bitartrate and of calcium tartrate, the latter being very large in proportion to the former in those countries, such as Spain and France, where it is the custom to add plaster to the grape juice before fermentation, whilst in Italian lees, where plaster is not used, the tartaric acid exists chiefly as the acid potassium salt. The beneficial effect of the addition of native plaster, which contains calcium

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carbonate, in reducing the acidity is due to the fact that calcium tartrate is precipitated, and a solution of neutral potassium sulphate produced in which potassium bitartrate is very slightly soluble. Argol is the impure potassium bitartrate deposited on the sides of the cask, whilst tartars, some of which contain as much as 76 per cent of tartaric acid, are manufactured from the argol by extraction with hot water and crystallisation. He had found that the indirect methods of estimating the amount of tartaric acid in these substances by determining the potash, lime, and sulphuric acid present, and calculating the tartaric acid as acid potassium tartrate, and neutral calcium tartrate, were open to grave objections, since the sulphuric acid present might exist either as potassium or calcium salt. These objections applied with still greater force to the analysis of lees. It was necessary, therefore, to devise a method for determinating the amount of tartaric acid directly. This was effected by adding a slight excess of potassium oxalate, neutralising with potash and separating the calcium oxalate precipitate. To the filtrate, which now contains all the tartaric acid as neutral potassium tartrate, citric acid is added in excess; this precipitates the tartaric acid as acid potassium tartrate, which is collected and weighed, a correction being made for that remaining in solution. It is a curious fact that, although pure citric acid can be neutralised by chalk, concentrated lime-juice cannot. This seems to be owing to the phosphoric acid and iron present in the latter, as it was found to be impossible to neutralise a solution containing iron, citric acid, and phosphoric acid even by protracted boiling with chalk.

The SECRETARY then read a paper "*On the Action of Nitric Acid on Copper, Mercury, &c., especially in the Presence of Metallic Nitrates*," by Mr. J. J. ACKWORTH. The results of the interesting experiments made by the author show that the action of cold dilute nitric acid on copper gives rise chiefly to nitric oxide, whilst nitric acid in the presence of a strong solution of cupric nitrate, yields nearly pure nitric oxide. With nitrate of ammonium and nitric acid, a mixture of nitrogen and nitrous oxide is evolved with varying amounts of nitric oxide. Nitrogen is chiefly produced by the action of nitric acid on zinc or iron in the presence of ammonic nitrate, and with mercury the result is similar, but the action is very sluggish. When silver is treated with the acid, the gases consist principally of nitric oxide and nitrogen, with mere traces of nitrous oxide, whilst, if ammonic nitrate be present, the proportion of nitrogen is very largely increased.

Dr. J. H. GLADSTONE then gave a short account of the "*Decomposition of Water by the Joint Action of Aluminium, and Aluminium Iodide, Bromide, and Chloride, Including Instances of Reverse Action*," by himself and Mr. A TRIBE. In order to throw some light, if possible, on the iodo-ethylate of zinc obtained in former reactions, the authors added iodine to aluminium foil and water. A large quantity of gas was evolved, which, on examination, was found to be hydrogen, the residue in the flask being aluminic oxide and iodide. This seemed to indicate that the decomposition of the water was effected by a series of decompositions and recompositions resulting from the joint action of the aluminium and the aluminium iodide, a supposition confirmed by the results obtained by the action of aluminium with hydriodic acid, and with aluminium iodide. A similar result was obtained with metallic zinc and aluminium iodide, but the action was more sluggish. The aluminium iodide may be replaced by the bromide as chloride.

"*On Nitrosyl Bromide and on Sulphur Bromide*," by Mr. M. M. P. MUIR. The author found that on passing nitric oxide to saturation into bromine at the ordinary temperature, a compound was obtained having the formula $NOBr_3$, the amount of nitric oxide absorbed not being sensibly affected by the pressure. This compound is readily decomposed by heat. On adding sulphur to bromine in the proportion 32 : 80, and agitating, the sulphur dissolves with development of a considerable amount of heat, forming a ruby red liquid, which has an odour resembling that of sulphur chloride. On submitting it to fractional distillation and analysing the portion boiling between 190° and 200°, it was found approximately to have the composition S_2Br_2. The author did not succeed in obtaining any other definite compound of bromine and sulphur.

"*On Achrematite, a New Molybdo-arseniate of Lead from Mexico*," by Professsor J. W. MALLET. This substance, which was put into the author's hands as a silver ore from the mine of Guanaceré, was found on analysis to contain no silver, but to be a molybdo-arseniate of lead approximating to the formula

$$3[3Pb_3(AsO_4)_2+PbCl_2] : 4[Pb_2MoO_5]$$

with an admixture of finely divided ferric oxide. The author gives detailed accounts of the analysis of it, and his reasons for believing it to be a distinct mineral and not merely a mixture of arseniate and molybdate of lead.

"*On Certain New Reactions of Tungsten*," also by Professor MALLET. The author finds, contrary to the statements in most manuals, that the precipitate produced by hydrochloric acid in the solution of an alkaline tungstate is to a great extent soluble in excess of the concentrated acid, and if zinc in fragments be gradually added to this solution, various colours will be produced, notably a magenta red, whilst a rich green is obtained if potassium sulphocyanate be added before the introduction of the zinc. If a mixture of an alkaline tungstate with a sulphocyanate in dilute solution be acidified with hydrochloric acid, and metallic zinc added, the liquid assumes a fine amethyst colour. The blue colour, well known as characteristic of one of the lower oxides of tungsten, may be most conveniently developed by the use of hyposulphurous acid (H_2SO_2) as the reducing agent. Details are given of the best methods of producing the phenomena just mentioned.

"*On the Action of Chlorine on Acetamide*," by Dr. E. W. PREVOST. The action of chlorine on acetamide, $C_2H_3O.NH_2$, was tried with the expectation that the NH_2 group would be removed and acetyl chloride, C_2H_3OCl, produced. It was found, however, that chlorine had no action in the cold, but when heated, the gas was absorbed and two crystalline substances produced, one of which is insoluble in ether and has a formula $C_4H_{11}N_2O_2Cl$, and the other, which is soluble, approximates to the formula $C_4H_8NO_2Cl$. There is little doubt but that the former is acetamide hydrochloride, $(C_2H_3ONH_2)_2HCl$.

Owing to the number and length of the papers read there was unfortunately no time for discussion at this meeting, the last of the session. The Society will not meet again until November next.

Prizes for Inventions.—The Prussian Government offers a prize of 3000 marks for a process which will give plaster casts the power of resisting periodically repeated washings, without in the least injuring the delicacy of the form or the tint of the material. A prize of 10,000 marks is also offered for a material for making casts of works of art, which shall possess all the good properties of plaster, but which, without any special preparation, will not deteriorate by periodically repeated washings. Competitors are to send with their consignments sealed envelopes bearing mottoes, and containing the names of the senders. On the *outside* of these envelopes is also to be written an address, to which the returned samples or any communications are to be sent. The samples which fulfil the requirements will become the property of the Prussian Government, and the names of the successful competitors will be published. The remaining samples will be returned to the addresses given on the envelopes. Competitors are to send in their samples to the "Kœnigl. Preussisches Ministerium der Geistlichen, Unterrichts- und Medicinal-Angelegenheiten," not later than Dec. 31, 1875.

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SOCIETY OF PUBLIC ANALYSTS.

At the meeting on June 2nd the following paper was read:—

ON THE ADULTERATIONS AND IMPURITIES OF TARTARIC AND CITRIC ACIDS.

By ALFRED H. ALLEN.

ALTHOUGH the nature of the ordinary impurities contained in these acids is well known, and most books on analysis profess to give methods for their detection, I have found some of the processes very unreliable, and others to require special precautions not always observed. In the following paper I have collected various data, and give the results of my experience with the hope that they may be found of value.

The principal accidental impurities of tartaric and citric acids are salts of potassium and calcium, together with iron, lead, and copper derived from the vessels used for the evaporation or crystallisation of the acid liquids. The presence of all these impurities is indicated by the proportion of ash left on igniting the specimen.

A number of samples of commercial tartaric and citric acids recently examined gave an amount of ash varying from 0·05 to 0·25 per cent.

The ignition is readily effected in a porcelain crucible over a Bunsen burner. Platinum vessels should be avoided, lest lead should be present: 5 or 10 grms. should be taken for the ignition. When the proportion of ash is small, it is of no interest to examine it further except for poisonous metals. Very sensible quantities of lead and copper are sometimes present. Of course their existence will be readily indicated on dissolving the ash in a few drops of nitric acid, diluting largely, and passing sulphuretted hydrogen.

A very fair approximative estimation of the lead or copper present may be obtained by placing the solution of the ash in a tall glass cylinder, and comparing the depth of tint produced by sulphuretted hydrogen with the tint obtained by treating an equal bulk of a very weak standard solution of lead or copper in a similar manner. The plan is identical with that recommended by Wanklyn for estimating the lead in water, except that sulphuretted hydrogen is substituted for ammonium sulphide. Experience has shown this to be necessary, owing to the frequent presence of iron, which, of course, gives a dark colour in an alkaline solution. I lay some little stress on this well-known fact, as I have recently examined some samples of aërated water which gave a deep brown colouration with ammonium sulphide, apparently indicating the presence of poisonous quantities of lead, but which further inquiry proved to be merely due to a considerable quantity of iron.

I prefer to examine the *ash* for poisonous metals instead of using the original sample of acid. The presence of copper is indicated on treatment of the ash with nitric acid in the crucible by the production of a blue colour.

Of course the presence of poisonous metals in tartaric and citric acids is always accidental, but as they are occasionally present in dangerous amount, it behoves the manufacturers to take every precaution to avoid their introduction, as the product containing them must be regarded as adulterated.

Many samples of citric acid contain free sulphuric acid, which may be known by the highly deliquescent character of the crystals. In testing citric acid for sulphates with chloride of barium, it is desirable to acidify rather strongly with hydrochloric acid.

The most common adulterant of citric acid, and almost the only substance purposely mixed with it, is tartaric acid, which is frequently found in the powdered samples sold in the shops. Many plans of detecting tartaric acid in admixture with citric acid have been proposed, but some seem to have been tried merely on the separate acids, and not on mixtures containing a comparatively small proportion of tartaric acid.

The ordinary method described in the text-books, of precipitating the tartaric acid from a cold neutral solution by addition of calcium chloride, I have found far from delicate, 10 per cent of tartaric acid in a sample escaping certain detection.

Messrs. Chapman and Smith found that a citrate, when boiled with a very alkaline solution of potassium permanganate (such as is used for the estimation of albumenoid ammonia), merely gave a green solution of alkaline manganate; but a tartrate, when similarly treated, caused a precipitation of brown manganese dioxide. I have been unable to verify these results, having failed to find any decided difference in the behaviour of the two acids.

Another proposed method of detecting this adulterant is to add excess of precipitated ferric hydrate to the aqueous solution of the sample, and to raise the liquid slowly to the boiling-point. The undissolved portion is allowed to settle, and the clear liquid is decanted off and evaporated to a syrup at a steam-heat. If tartaric acid is present, even in very small proportion, it is said to cause the deposition of a pulverulent precipitate of ferric tartrate, while the liquid obtained from pure citric acid remains clear. I have been unable to detect moderate percentages of tartaric acid by this test.

The best test for detecting an admixture of tartaric acid is the well-known one of a salt of potassium. It is remarkable how very few of the ordinary works on analysis make any mention of the precautions necessary for the successful detection of tartrates or potassium by their mutual reaction. If aqueous tartaric acid be added to a strong solution of the chloride or nitrate of potassium, a precipitate of the acid tartrate will often occur, but its formation is greatly impeded by the mineral acid set free. This may be proved by filtering off the liquid and treating it with a strong solution of sodium acetate, when a copious additional precipitation takes place, owing to the replacement of the free hydrochloric or nitric acid by acetic acid, and the insolubility of the acid potassium tartrate in the latter. Of course, the same object is attained by using excess of acetate of potassium as the precipitant instead of the nitrate or chloride. The precipitation is greatly promoted by stirring, the precipitation forming well-defined and characteristic streaks in the track of the glass rod. Of course the liquid must be quite cold. The delicacy of the reaction is greatly increased by the addition of alcohol.

A recognition of this fact suggested the possibility of rendering the test quantitative and delicate by using alcoholic instead of aqueous solutions of the sample and reagent. Tartaric and citric acids are both soluble in absolute alcohol, but the potassium salts are insoluble. Acid tartrate of potassium is also practically insoluble in proof spirit, while the citrates of potassium are pretty readily soluble in weak alcohol. In the following experiments I employed a proof spirit made by diluting ordinary methylated spirit with water till it had a density of 920:—

Some pure potassium-hydrogen tartrate was prepared, and its solubility in proof spirit at 16° C. proved to be 0·05 per cent, or 1 grm. in 2000 c.c. of spirit.

A saturated cold solution of potassium acetate in proof spirit was prepared. 100 c.c. contained about 36 grms. of the salt, so that 5 c.c. suffice for the precipitation of nearly 3 grms. of tartaric acid.

A series of samples of citric acid were prepared, containing from 5 to 50 per cent of tartaric acid.

Quantities of 2 grms. of each of these adulterated samples were dissolved in 20 c.c. of proof spirit, 5 c.c. of the saturated spirituous solution of potassium acetate was added, and the solution stirred and left over night. It was then filtered, the precipitate was washed with proof spirit saturated with acid potassium tartrate, and then once with ordinary proof spirit. The precipitate was then washed off the filter with hot water into a light porcelain dish, the water evaporated off at a steam heat, and the dry $KH\bar{T}$ weighed and calculated into tartaric acid.

It was boped that, by proceeding in this manner, very accurate estimations of tartaric acid could be made, as there could be no loss except from the slight solubility of the precipitate in the solution, for which a correction could readily be made on the assumption that the citric acid and potassium acetate present had no influence on the solubility of potassium-hydrogen tartrate in proof spirit. To my surprise, however, the results obtained, even without the correction for solubility, showed sensibly more tartaric acid than had been actually added to the sample. A fresh series of experiments was made, exactly the same method being employed, except that the 2 grms. of the samples were dissolved in 40 c.c. of proof spirit instead of 20 c.c. as before, thus making the volume of the solution 45 c.c. By thus proceeding I obtained the following results, without the correction for solubility, which would make the numbers 1·1 per cent higher still :—

	Tartaric Acid Added.	Tartaric Acid Found. By Precipitation.	Tartaric Acid Found. By Alkalinity of Ash.
No. 1	10	10·55	9·70
No. 2	20	20·70	20·40
No. 3	30	33·35	35·50
No. 4	40	43·50	42·25

In this series of experiments, the results were checked by igniting the precipitate and titrating the ash with standard acid. It was found that the carbon left retained alkali tenaciously, and, after dissolving the ash in water, it was necessary to ignite the black residue and then add its ash to the main quantity. In the above cases, the amounts of potassium carbonate found by the titration of the ash correspond to the percentages of tartaric acid shown in the last column of the table.

A convenient plan of estimating the tartaric acid volumetrically is to dissolve the precipitate in hot water and titrate the solution volumetrically. This plan gives results closely according with those obtained by direct weighing when pure tartaric acid is employed.

Another series of experiments was conducted in an exactly similar manner, except that the precipitate was washed with proof spirit which had *not* been previously saturated with acid potassium tartrate. The following results were obtained, no correction being made for solubility of the precipitate in the mother-liquor :—

	Tartaric Acid Added.	Tartaric Acid Found. By Weight of Precipitate.	Means.	Tartaric Acid Found. By Alkalinity of Ash.
	Per cent.			
No. 1	10	10·00	10·04	10·50
,, 1A	10	10·25		10·10
,, 1B	10	9·88		—
,, 2	20	20·90	21·30	22·02
,, 2A	20	21·71		—
,, 3	30	31·50	30·73	31·59
,, 3A	30	29·96		—
,, 4	40	43·10	43·91	43·57
,, 4A	40	44·71		—

These estimations were very satisfactory when the proportion of tartaric acid did not exceed 20 or 30 per cent, but there was a uniform tendency towards too high a result. The discrepancies observed seemed attributable to—(1) The presence of tartaric acid in the sample of citric acid employed; (2) precipitation of an acid citrate together with the potassium-hydrogen tartrate.

Apart from direct experiment having proved the absence of tartaric acid in the original citric acid used, the invalid nature of the first explanation is shown by the fact that the *less* citric acid used the *greater* was the excess of tartaric acid found over that added.

Experiments were then made with the view of ascertaining whether the discrepancy was due to the second cause.

A quantity (2 grms.) of the citric acid was treated in exactly the usual manner, and gave no evidence of the presence of tartaric acid. On the following morning the liquid was again stirred, the temperature being only about 8° C., when well-defined streaks were produced in the track of the glass-rod, and in a few minutes the liquid became semi-solid from the formation of a crystalline precipitate. Either the sample was largely contaminated with tartaric acid, or the cold had induced the separation of potassium citrate. The latter, as might be expected, proved to be the truth, warming causing the precipitate to disappear gradually, while, on decanting off the alcoholic liquid and adding a moderate quantity of cold water, the precipitate dissolved instantly. The fact deserves special attention, as an ignorance of it might readily lead to a sample of citric acid being condemned as largely adulterated with tartaric acid, when the latter substance was entirely absent.

The above observation naturally gave the clue to the anomalous results already obtained. In the concentrated and highly alcoholic solutions used there was a tendency to the precipitation of potassium citrate along with the tartrate. This tendency seemed capable of correction by treating the washed precipitate with a cold saturated aqueous solution of potassium-hydrogen tartrate, which would readily dissolve any precipitated citrate without acting on the acid tartrate. The following experiments show the result of this treatment :—

	Tartaric Acid Added.	Tartaric Acid Found. Precipitate Washed with Proof Spirit.	Tartaric Acid Found. Same Precipitate after treatment with Aqueous $KH\bar{T}$ Solution.
	Per cent.	Per cent.	Per cent.
No. 1..	20	21·00	20·96
No. 2..	40	44·60	38·77

In this case the results obtained from the sample containing 20 per cent of tartaric acid were almost within the limits of error, while the reduction of the weight of the precipitate in No. 2 by an amount equal to nearly 6 per cent of tartaric acid conclusively shows that the previous excess was due to citrate carried down by the tartrate precipitate. If, to the result obtained in No. 2, we add 1·1 per cent, as correction for solubility of the $KH\bar{T}$ in the mother-liquor, we obtain 39·87 per cent of tartaric acid found, as against 40 per cent added.

An attempt was next made to obtain a precipitation in an *aqueous* solution, using proof spirit merely for washing the product. Two quantities dissolved in ten times their weight of water gave by this method 35·15 and 16·85 per cent of tartaric acid respectively, instead of 40 per cent and 20 per cent added.

I next made some experiments in which a cold saturated aqueous solution of potassium-hydrogen tartrate was used as the solvent of the sample, but the results were unsatisfactory.

The results of the whole of the above experiments have led to the use of the following process, which, while readily detecting 2 or 3 per cent of tartaric acid, allows of the estimation of larger proportions with very fair accuracy :—

Dissolve 2 grms. of the sample to be tested in 45 c.c. of proof spirit, filter from any undissolved calcium or potassium tartrate, add 5 c.c. of a cold saturated solution of potassium acetate in proof spirit, stir, and allow to stand for twelve hours. Filter off the precipitate produced and wash it with proof spirit. Rinse off the precipitate from the filter with a saturated solution of potassium-hydrogen tartrate in cold water, digest in the cold for a few hours with occasional stirring, then filter, wash once with proof spirit, rinse off the precipitate into a small porcelain dish with boiling water, evaporate at 100° C., and weigh the acid potassium tartrate obtained. The weight, multiplied by 0·798 (or, roughly, 0·8), gives the quantity of tartaric acid in 2 grms. of the sample examined. As a check, the dry precipitate may be

ignited and the solution of the ash titrated with standard acid; or the same method (substituting standard alkali for acid) may be applied to the purified precipitate on the filter, so as to avoid the trouble of the subsequent evaporation at a steam heat.

Since the above experiments were made, I have found that a closely analogous method has been described by E. Fleischer; but, by strictly following his directions, I found that a precipitate was obtained containing a considerable admixture of citrate.

If any doubt whatever exists as to the precipitate produced by potassium acetate being really the acid tartrate, its insolubility in cold water will readily settle the question, but positive proof is readily obtained by the silver test, which is extremely delicate when carefully applied, but remarkably liable to failure if the proper conditions are not carefully observed. The following plan of operation gives very good results:—

A small quantity of the precipitate of acid potassium tartrate is washed with a little cold water, and then treated with a slight excess of ammonia. The resultant solution is boiled till neutral, allowed to cool, and then precipitated with *excess* of argentic nitrate. To the liquid containing the precipitate dilute ammonia is added till the precipitate has almost disappeared, when the solution is filtered. On heating the filtrate nearly to boiling for a few minutes, a brilliant mirror of metallic silver is produced on the sides of the tube. Citric acid does not reduce silver under similar circumstances, except on continued boiling.

After the precipitation of the tartaric acid in a solution by addition of potassium acetate, the citric acid may readily be detected in the filtrate (after evaporating off the alcohol) by applying the ordinary tests.

Muter's "Chemistry" contains a method of separating tartaric and citric acids by converting them into calcium salts and treating the precipitate with a perfectly neutral solution of cupric chloride, when calcium chloride is produced, together with soluble cupric citrate, while cupric tartrate remains insoluble. I have had no experience of this process, but it looks very promising, especially for the examination of citrates supposed to contain tartrates.

Mr. Wigner has suggested that the power possessed by solutions of tartaric acid of altering the plane of polarisation of a transmitted beam of light, would enable an accurate estimation of that acid to be made in the presence of citric acid, which is inactive. The method would evidently give a practised observer very good results in cases in which the adulterant was all *dextro*-tartaric acid, but would fail if the sample contained racemic, lævo-tartaric, or inactive tartaric acid. This objection does not apply to the estimation as a potassium salt.

Oxalic acid is said to be sometimes employed as an adulterant of citric acid. This dangerous admixture would, of course be readily detected by treating the aqueous solution of the sample with excess of ammonia, acidifying with acetic acid, filtering from any precipitated acid-ammonium tartrate, and testing the filtrate with calcium sulphate.

In conclusion, I desire to express my thanks to Mr. Wm. Galbraith, who has performed most of the manipulations described.

NOTE ON DR. CAMPBELL BROWN'S RECENT PAPER ON MILK.

To the Editor of the Chemical News.

Sir,—There was some discussion on Dr. Brown's paper which was read at the Society of Public Analysts, and appeared in last week's Chemical News, and as by some accident that discussion was *not* reported, I take this opportunity of putting forward my views on the subject.

It is, perhaps, unnecessary that I should warn chemists against following Dr. Brown's advice to take 40 or 50 c.c. of milk for evaporation instead of the 5 c.c. recommended in my little book on "Milk Analysis." The convenience and advantage of the smaller over the larger quantity is appreciated by many persons, but, for the benefit of such persons as may have adopted the larger quantity, I will just remark that by taking 5 c.c. of milk, results correct to within a small figure in the second decimal place in percentage may be obtained in from three to four hours, whilst a like accuracy is not attainable in the space of eight hours if the large quantity be taken. I am indeed in some doubt as to whether it is possible to make a perfect desiccation of the larger quantity without some degree of decomposition setting in.

Dr. Brown's advice to maintain the milk residue at 99° C. for one hour in the air-bath before being weighed, appears to me to be quite superfluous. I never do anything of the kind, and my milk dishes containing the dry residues are taken out of the water-bath, wiped, and at once weighed.

According to Dr. Brown's experiments the "solids not fat," which usually amount to 9·3 per cent of the milk, fell in three instances out of about 400 samples of milk to a little below 9·0 per cent, *viz.*, to 8·94, 8·95, and 8·81. The limit which is accepted by the Society of Public Analysts is 9·0 per cent.

I cannot help remarking that the result of this investigation, as far as it goes, is favourable to the official standard, the numbers 8·94 and 8·95 being sufficiently near the standard, whilst there thus remains only one contrary number, *viz.*, 8·81, out of the analyses of some 300 to 400 samples of milk; and possibly if Dr. Brown had operated upon 5 c.c. of milk instead of upon 40 or 50 c.c., he would not even have met with this one contrary instance. Be this, however, as it may, this isolated instance is quite unimportant to the Public Analyst.—I am, &c.

J. Alfred Wanklyn.

117, Charlotte Street, Fitzroy Square,
June 22, 1875.

NOTICES OF BOOKS.

Year-Book of Pharmacy, Comprising Abstracts of Papers Contributed to British and Foreign Journals from July 1, 1873, to June, 1874. With the *Transactions* of the *British Pharmaceutical Conference* at the Eleventh Annual Meeting held at London, August, 1874. London: J. and A. Churchill.

It is not every book of which the title explains so fully its aim and object, and very few, indeed, are there that profess much in their titles which will bear investigation so well as the volume under notice. As the official record of a peripatetic society modelled after, and usually following, the British Association, it is given away to the thousand and one members who pay the very moderate subscription required, and it is not too much to say that the book alone is well worth the money, even if there were no other advantages to be enjoyed by the members. The "Year-Book of Pharmacy" has hitherto been edited by Professor Attfield, but the present volume has been compiled by Mr. Louis Siebold, of Manchester, and very well this gentleman has performed his difficult task.

In addition to the abstracts of papers which have appeared in the Chemical News, or which deal with matters relating to pure pharmacy, there are many others connected with pharmaceutical chemistry in its widest sense, and which will well repay a careful perusal. The Public Analyst especially will get many a hint for the detection of ill-defined organic bodies, and for the invention of new methods of analysis.

A valuable feature of the book, which might be advantageously adopted in other cases, is the "*introduction*," which is in effect a very useful summary of the chief

discoveries of the year and of the leading facts and processes afterwards detailed.

The arrangement and type of the book are unexceptionable, and the *errata* not more numerous than must be expected in a work of the character.

CORRESPONDENCE.

SILVER-AMMONIUM ALUM (?).

To the Editor of the Chemical News.

Sir,—With reference to the query of Mr. S. E. Phillips as to this substance, in your last issue, I noted the incorrectness in M. Sergius Kern's note (Chemical News, vol. xxxi., p. 209), and have waited to see whether anyone would correct him. Professor Church has shown that what he stated as new about Ag-Al alum was already known.

The query of Mr. Phillips touches the erroneous view of M. Kern as to what constitutes an alum. I presume it is generally well known that, letting M represent an atom of a monad basylous element or radicle, and M''' an atom of a triad or pseudo-triad one, the alum-type is—

$$M_2M'''_2(SO_4)_4,24OH_2 \text{ or } M_2SO_4M'''_2(SO_4)_3,24OH_2.$$

I cannot admit the truth of Mr. Phillips's remark, that "the difference of character," or constitution of these salts, "may, perhaps, be better seen by using the old notation." It may be by him, since he generally adopts it, but not necessarily so by others. It is evidently a matter of training and use.

The *so-called* silver-ammonium alum does not conform to the alum type given above, even if we assume M. Kern's formula, $Ag_2(NH_4)_2(SO_4)_2,24OH_2$, to be correct, ammonium being a *monad* radical, and not a triad one; consequently the salt is a double sulphate of silver and ammonium, and *not* an alum at all. M. Kern speaks of the crystals being "isomorphic;" he leaves it to be inferred that he means *with the alums*, which, I believe, on examination, it will be found not to be.

Further, I submit that M. Kern has very likely *assumed*, without making any determination, that the salt contains 24 molecules of water of crystallisation, like the alums, and that, if he will examine the salt with regard to this point, he will probably find that it contains *two* molecules of water of crystallisation rather than twenty-four, its formula being—

$$Ag(NH_4)SO_4,2OH_2,$$

corresponding to—

$$Na(NH_4)SO_4,2OH_2,$$

a double sulphate the constitution of which is known.—I am, &c.,

W. H. Wood.

Halifax, June 22, 1875.

ON THE MINIMUM SOLIDS IN MILK.

To the Editor of the Chemical News.

Sir,—In Chemical News, vol. xxxi., p. 267, there appeared a "Table showing the Adulteration by Water of Milk which originally contained the Minimum of 11 per cent of Solids, including Fat." It begins with 11 per cent and is carried down to 1 per cent of solids, which latter quantity is equal to 10 parts of water added to 1 part of the poorest milk; an adulteration which it would scarcely require an analyst to detect, and which, in fact, might be considered as water adulterated with milk. I think it would have been sufficient to have given the minimum amount of solids which Dr. Campbell Brown considers as the standard to be taken in prosecutions for adulteration, and to have let chemists calculate for themselves (and surely they are capable of doing so) the amount of adulteration in any given sample.

Half the table might certainly have been omitted, as no milkman is likely to add to his milk more than an equal amount of water; and the other half can only be of use when the percentage of solids in the sample under examination coincides with the figures in the first column.—I am, &c.,

A. S.

Stoke Newington, June 19, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 19, May 17, 1875.

Chemical and Physiological Ferments.—M. A. Müntz.—The author points out the distinctions between these two classes of ferments. The ferments endowed with life have their maximum action at temperatures from 25° to 40°. The generality of chemical ferments have their maximum action at higher points. Chloroform entirely arrests all fermentation depending on vital action, but is without influence on purely chemical fermentation.

Experiments and Observations on the Viscous Fermentation.—M. A. Baudrimont.—The viscous fermentation, at least at its commencement, is not due to an alteration of the sugar, but simply a special development of the ferment which it contains.

No. 21, May 31, 1875.

Researches on the Sulphines.—M. A. Cahours.—The author examines the action of the bromide of benzyl on the sulphide of methyl; of the iodide of methyl upon the sulphide of methyl; of the di-iodide of methylen upon the sulphide of methyl; and of the bromide of ethylen upon the same compound.

Alteration of the Seine from November, 1874, to May, 1875.—M. A. Gérardin.—The author judges of the amelioration of the water by determining the amount of dissolved oxygen.

New Method of Preparing Highly Concentrated Formic Acid by means of Dehydrated Oxalic Acid and a Polyatomic Alcohol.—M. Lorin.—Into a rather large tubulated retort is introduced white glycerin, which is concentrated by heat before the addition of the dehydrated oxalic acid in powder. The retort is heated in the water-bath. Decomposition takes place about 80°, but it is much accelerated by a slight rise of temperature, and at 87° the liquid is covered with a layer of bubbles half a centimetre in thickness. When the decomposition slackens more oxalic acid is added. The formic acid is absolutely free from allyl compounds, and contains 94 per cent of actual acid.

Isomerism of the Hydrochlorates, $C_{10}H_{16}HCl$.—M. J. Ribau.—Hydrochlorate of terebenthen is absolutely undecomposable by cold water; it only gives off very slight quantities of hydrochloric acid at 100°, and rapidly loses the totality of its acid at 200°, becoming converted into tereben. Stearate of soda and alcoholic potash transform it into active camphene, and acetate of soda into the inactive form. Hydrochlorate of tereben is rapidly decomposed by cold water with production of β-camphene; by water at 100°, with regeneration of tereben as a liquid body. Stearate of soda changes it into a mixture of regenerated tereben and of β-camphene. The mono-hydrochlorate of the various camphenes is slowly decomposable by cold water; with water at 100°, with alcoholic potash and stearate of soda it regenerates camphene as a solid body. The hydrochloric ether of the borneols having the same formula, behaves like the latter series

of bodies, and belongs, consequently, to the hydrochlorate of camphene type.

Origin of the Phylloxera at Cognac.—M. Mouillefert.

Use of the Xanthate of Potash against the Phylloxera.—MM. Zœller and A. Grete.—This salt liberates sulphide of carbon, fatal to the phylloxera, especially in contact with superphosphate.

Presence of the Phylloxera in Auvergne.—M. Julien.

Influence of Moisture on the Phylloxera.—M. Villedieu.—In dry weather the phylloxera descends; in rainy weather it approaches the surface.

Researches on the Rapidity of Magnetisation and Demagnetisation of Iron, Cast-Iron, and Steel.—M. Deprez.—Soft iron, common iron, malleable cast-iron, and even tempered steel give approximately the same results for the duration of the phases of magnetisation and demagnetisation.

Rotatory Power of Crystalline Sugar, and on the Sampling of Sugars Submitted to Polarimetric Analysis.—MM. V. de Luynes and A. Girard.—Optical saccharimetry is based essentially on the following data:—The graduation of the apparatus and the taking of the sample. The graduation of the apparatus is such that 100 saccharimetric degrees correspond exactly to the rotation produced by a plate of quartz perpendicular to the axis, and measuring 1 m.m. in thickness. The sample is represented by the weight of pure sugar which would, under the same conditions, produce the same rotation as this plate of quartz. Sometimes, when proceeding on these data, we observe singular anomalies. Samples are met with which mark by the saccharimeter 100·5°, and even 101°. The authors agree with M. Dubrunfaut that 16·35 grms. is too large a quantity to take for optical examination, and that the proper weight is 16·19 grms.

Remarks Concerning a Paper by M. Gayon on the Spontaneous Decomposition of Eggs.*—M. A. Béchamp.—The author denies that putrid eggs invariably contain bacteria or vibriones.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 17, May, 1875.

Report Given by Count du Moncel on the Telegraphic Indicator for the Use of Hotels.—M. Debayeux.—This paper requires the accompanying illustration.

Report Given by M. Cloëz on the Superphosphate Works of MM. Michelet and Thibault.—The peculiarity of this establishment is that the phosphates are mixed with the acid in closed vessels from which the noxious vapours are drawn by an aspirator, traverse a tower filled with wet coke, and pass finally into the chimney of the works. The phosphatic minerals are ground and sifted for use, and the acid is employed at 53° B. The phosphorites used are those of the Lot, the Ardennes, and of Estremadura. The vapours given off by the first-mentioned kind yield a certain amount of iodine. The arrangement of the plant cannot be made intelligible without engravings.

Report Presented by Count du Moncel on the Thermo-Electric Battery of M. Clamond.—In this battery the electro-positive element is of iron, and the negative element an alloy of antimony and zinc. In M. Clamond's arrangement, as in that of Mr. Farmer, the elements are connected circularly for intensity, forming a kind of crowns, isolated from each other by plates of amianthus, and having their polar extremities placed in connection with a commutator, fixed tangentially to the cylindrical surface of the apparatus, and contrived so as cause these crowns to be grouped either for intensity or for quantity, as may be requisite. The apparatus has been employed for six months at the galvano-plastic works of M. Goupil at Asnières. The gas consumed amounts to 2¼ frs. per kilo. of copper deposited. This paper is accompanied with several illustrations.

New Balance of M. Mendeleef.—Requires the accompanying diagram.

Observations on the Use of the Tincture of Guiacum as a Test for the Purity of Kirschwasser.—M. Boussingault.—The blue colouration relied on as a characteristic of genuine kirsch is due to traces of copper. In presence of hydrocyanic acid tincture of guiacum is the best reagent for this metal.

Central-Blatt fur Agrikultur Chemie, Heft 3, March, 1875.

Periodicity of Hail.—Prof. H. Fritz.—The author finds that the seasons when hail is most frequent are those in which spots in the sun are most numerous. On the other hand, the years when solar spots are at their minimum are characterised by the rarity or absence of hail. It has also been observed that when the aurora is very frequent during the winter, frequent hail-storms occur in the following summer.

Studies on Arable Soils.—Th. Schlösing.—The author has examined the influence of the salts present in a soil upon its openness of texture. Mould stirred up in water subsides the more rapidly the more salts are present, especially those of lime and magnesia. This phenomenon, which amounts to a coagulation of the clay, is thoroughly examined. The best precipitants for clay are caustic lime and the lime salts.

Contribution to the Knowledge of Arable Soils.—Prof. W. Knop.—The author gives the analysis of the sediment of the former lake, Fucino, near Avezano, in the Abruzzi (now drained). This soil, like the mud of the Nile, though very fruitful, contains little humus.

Utilisation of the Waste Hydrochloric Liquid from the Manufacture of Bone-Glue.—Dr. P. Wehle.—The dilute muriatic acid used in extracting the bone-earth from the gelatin is neutralised with milk of lime, when phosphate of lime is deposited in a state of fine division.

Residues of the Olive Oil Manufacture, and their Utilisation as Manure.—Prof. F. Sestini and G. del Torre.—The dregs of the oil, and the black water which flows out of the press along with the oil, are useful as manure, after their acidity has been previously neutralised with lime. The olive-cake is of little value.

Solution of Phosphorite by Admixture in Composts.—Dr. F. Holdefleiss.—The author has attempted to render the Nassau phosphorite—unfavourably known from its tendency to "reversion"—soluble by mixture with various organic matters. Peat, especially in company with ammoniacal salts, gave the best results.

A New Contribution to the Sewage Irrigation Question.—An account of the Leamington irrigation farm, taken from *Der Landwirth*. The milk of cows fed on the sewage grass is said to have been analysed by Dr. Swete, who found it "very rich, and not in the slightest degree infected." The editor judiciously remarks that the "rentability" of sewage farms can only be decided by accurate balance sheets.

Quantity and Quality of the Milk of Cows of Different Breeds and Strains.—Messrs. Kildal, Elstrand, Dirks, Moser, and Belleville.—These researches prove that the composition of genuine milk fluctuates very little. In all the quantities examined, the lowest amount of water was 86·58 per cent, and the hightest 88·18.

Experiments on the Chemistry of the Process of Saccharification by means of Malt.—Dr. P. Wagner.—In grain distilleries farina is converted into a mixture of glucose and dextrin by the addition of malt. The production of lactic and acids should be carefully avoided since they both have a destructive action upon diastase.

Detection of Adulterated Wines.—Prof. J. Nessler. The author points out that genuine wines contain, chiefly

* *Comptes Rendus*, lxxx., p. 1096.

malic acid. Free tartaric acid is very rarely found, except in spurious concoctions. As a test the author uses a solution of 5 grms. acetate of potash, 5 grms. alcohol, and 25 grms. water. If an appreciable amount of tartaric acid is present, this test produces a crystalline deposit of tartar in a quarter of an hour; whilst, in genuine wines, even if they contain a trace of tartaric acid, no precipitate appears until some hours have elapsed. Genuine wine contains no citric acid. For its detection in small quantities, the wine is rendered alkaline and filtered, acidulated with acetic acid, mixed with chloride of barium, filtered, and a few drops of ammonia added to the fillrate until it has an alkaline reaction. If, on the addition of baryta-water, a white precipitate appears, citric acid is present. Oxalic acid gives a white precipitate if lime-water is added in such small quantities that the liquid has still an alkaline reaction. Sulphuric acid in genuine wines is found only to the extent of 0·03 to 0·05 per cent.

Influence of Phosphates and of Certain Gases upon Putrefaction.—L. Lefort and V. Paschutin.—The authors confirm the results of Collas on the putrefactive agency of gelatinous phosphate of lime. They find no volatile compounds of phosphorus—such as phosphide of hydrogen—among the products of putrefying organic bodies. Muscular flesh, preserved for ten months in various gases free from oxygen, did not putrefy, but when afterwards exposed to the air they underwent decomposition almost as rapidly as recent flesh.

Les Mondes, Revue Hebdomadaire des Sciences.
No. 1, May 6, 1875.

This number contains no original chemical matter.

No. 2, May 13, 1875.

Electro-Dynamic Machine.—M. H. Fontaine.—A reply by the author to a paper in which the invention of Gramme's electro-magnetic machines is claimed for M. Lonten.

Determination of Tannin.—A. Carpeni.—The reagent proposed is ammoniacal acetate of zinc, with a great excess of ammonia. It forms a tannate of zinc, quite insoluble in water, ammonia, and an excess of the reagent. The precipitate is heated almost to a boil, and, after cooling, it is collected on a filter, and washed with boiling water. It is then re-dissolved in dilute sulphuric acid, and determined by means of permanganate of potash, $-1° = 0·0076$ grm. of tannic acid.

Reimann's Farber Zeitung, No. 16, 1875.

This issue contains a notice of the origin and development of the manufacture of bismark brown (phenylendiamin brown). There follows the conclusion of the paper on dyeing half-woollen doubles; receipts for a red, a yellow, and a prussian green on jute; for printing a chrome grey on calico; for a fast ponceau on woollen piece goods and on wool; receipts for burling inks; an indelible and bleach-proof ink for marbling cotton and linen pieces; and an improved method of printing fast blues. This process, proposed by Jeannaire, is as follows:—He mixes ground indigo with soda-lye, and the tartrate either of protoxide of tin (stannous tartrate), or of protoxide of iron (ferrous tartrate), thickens with dextrin, and prints. The colour is kept thin, and is heated to 30° to 40° for use, and mixed with 1 to 2 per cent of petroleum to prevent frothing. Before printing, the goods are passed through glycerin (1 to 2 parts of glycerin to 16 of water), or a mixture of glycerin and arsenic, or glycerin and tin-crystals, 25 grms. per litre, may be used. After printing, the pieces are hung, the next day, in a current of water, or passed the ame day through sulphuric acid at sp. gr. 1·01, washed, and soaped. The tartrate of protoxide of iron is prepared by dissolving 500 grms. protochloride of iron, 1 kilo. of tartaric acid, and 50 grms. of tin-crystals, in the smallest possible quantity of hot water.

MISCELLANEOUS.

Filtered Thames Water, and Spring Water from Chalk Strata.—S. C. Homersham, in the *Journal of the Society of Arts*, May 28, 1875, holds that spring water from the chalk strata has a uniform annual temperature varying little from 50° F. That it is clear, transparent, bright, and, in large bulk, of a pure blue colour. That it holds in solution per gallon two or more cubic inches of oxygen and six of nitrogen. That it is free from living organisms, vegetable or animal, and from all dead organic matter, whether in suspension or solution. On the other hand, he urges that filtered river water has in summer a temperature of 68° to 72° F., and in winter of 34° to 36° F. That it is more or less opaque, and devoid of transparency and brightness; that it holds in solution a smaller quantity of oxygen than does spring water, and that it contains in suspension manure, fæcal matters, living organisms, animal and vegetable, and the virus of specific diseases. He calculates that as the average thickness of the chalk is 800 ft., it would take a depth of 260 ft. of rain, or the produce of two centuries, to saturate the pores, and infers hence that so slow and delicate a process of filtration may naturally be expected to produce results superior to the coarse and rapid filtration of water companies.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Soap for Scouring Woollens.—Will some reader of the Chemical News kindly inform me how to make a good soap suitable for scouring woollen yarn?—S. G.

Osmosis, Dialysis, and Diffusion.—Could any of your readers inform me of the best book written on osmosis, dialysis, and diffusion, &c., as I wish to study the subject?—A Reader.

Action of Vinegar on Tin.—Can any correspondent inform me whether the vinegar of commerce attacks the tins used in preserving meats, and whether the same extracts any poisonous ingredients from such tins?—B. S.

MEETINGS FOR THE WEEK.

Saturday, June 26th.—Physical. "On the Electrical Conductivity of Liquids," by W. J. Wilson. "On Subjective Sensations of Taste," by Dr. W. H. Stone.
Wednesday, June 30th.—Society of Arts, 4. (Anniversary.)
Friday, July 2nd.—Geologists' Association, 8.

British Association for the Advancement of Science.

22, Albemarle Street, London, W.

The NEXT ANNUAL GENERAL MEETING will be held at BRISTOL, commencing on Wednesday, August 25.

President:

SIR JOHN HAWKSHAW, C.E., F.R.S., &c.

Notice to Contributors of Memoirs.—Authors are reminded that, under an arrangement dating from 1871, the acceptance of Memoirs, and the days on which they are to be read, are now, as far as possible, determined by Organising Committees for the several Sections before the beginning of the Meeting. It has therefore become necessary, in order to give an opportunity to the Committees of course justice to the several communications, that each author should prepare an Abstract of his Memoir, of a length suitable for insertion in the published Transactions of the Association, and that he should send it, together with the original Memoir, by book-post, on or before August 11, addressed thus:—"General Secretaries, British Association, 22, Albemarle Street, London, W. For Section....." If it should be inconvenient to the Author that his Paper should be read on any particular day, he is requested to send information thereof to the Secretaries in a separate note.

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INDEX.

ABESSER, O., composition of potatoes, 208
researches on the methods of determining phosphoric acid, conducted at the Agricultural Station at Halle, on the Saale, 161
Abria, M., internal double reflection in bi-refringent uniaxial crystals, 196
laws of double interior reflection in bi-refringent uniaxial crystals, 8
Absorption spectra, new way of observing, 255
Acetamide, action of chlorine on, 276
Acetic acid, anhydrous, 172
in presence of mineral acids, 173
Acetic and formic acids, mutual displacement of, 251
Acetone, action of ammonia on, 109
Acid in gastric juice, source of, 218
Acids, dilute mineral, action on bleaching-powder, 268
Ackworth, J. J., action of nitric acid on copper, mercury, &c., especially in the presence of metallic nitrates, 276
Address delivered before the British Association at Belfast, 18
Adulterated wines, detection of, 281
Adulteration Acts, 115
of Food and Drugs Act, 95
"Advantages of a Separate System of Drainage" (review), 237
Aerated waters, presence of lead and copper in, 77
Aerial corpuscles, and saline matter in snow, 60
Agricultural chemistry of the tea plantations of India, 256
"Agriculture, Report of the Commissioner of, for 1873" (review), 128
"Air as Fuel" (review), 39
Airthrey springs at Bridge of Allan, analysis of the, 88
Albumen, 239, 250
coagulation of, 51
determined by tannin, 141
Albuminoid matters, 98
Albuminoids, neurin with, behaviour of, 131
Alcohol, amylic, detection of in spirits of wine, 197
methylic, determination of in presence of vinous alcohol, 239
mixed with wood spirit, ordinary, 238
Alcoholic yeast, 22
Aldehyd, action of heat on ordinary, 240
Aldehyd, transformation of benzamide into, 21
Aldehyds, 31
Alizarin, distinction between artificial and natural, 99
manufacture of, 142
Alkali Act, 7
Alkalies in beet-root, equivalence of, 229
Alkaline salts on the vegetation of the beet-root and the potato, part exercised by, 229
sulpho-carbonates against the Phylloxera, use of, 239
Alkaloids on certain properties of hæmoglobin, influence of the, 109
Allen, A. H., adulteration of coffee, 208
Alloys, certain Japanese, 32
new method of quantitative analysis of ordinary, 76
of platinum and iron, 172
Alum, chrome, solutions of, 19
in bread, detection of, 66
silver ammonium, 280
type, 268
Alumina in cryptogamous plants, 218
phosphoric acid, and iron sesquioxide, methods of obtaining quantitative separation of, 214
Aluminium and silver, double sulphate of, 209
Allantoin, synthesis of a homologue of, 19
Amato, D., meta-santonin, 21
"American Pharmaceutical Association at the 21st Annual Meeting, Proceedings of the" (review), 82
Ammonia, action of on aceton, 109
derivatives of benzol, 61
distillation of, in presence of sulphocyanides, 15
method, examination of waters by the, 233
of commerce, detection of tarry matter in, 250
of the atmosphere, 84
soda process, 95
Ammoniaco-magnesian phosphates, 240
Ammonio-silver carbonate, 231
Amylen, 40
Analyses, commercial, 8
Analysis of buffalo's bones, 218
of Cambridge coprolite, 209
of crude anthracen, 209
of mud, taken at low water from the Mer Rouge, 274
of one of the Trefriw mineral waters, 27
of sugar, 212, 261
of the Airthery springs at Bridge of Allan, 88
quantitative, of cinnabar, 266
"Analysts' Annual Note-Book, 1874" (review), 196
Anderson, J. B., manufacture of caustic soda, 160
Andrewsite and chalkosiderite, 213
Angell, A., fusing-point of fats, 226, 238
Anhydrous sulphuric acid in the gaseous products of the combustion of iron pyrites, 260
Aniline black, 99, 120
with ferrocyanide of aniline, 173
colours without the use of arsenic acid, production of, 83
inks, 229, 261
Anthon, F., formation of molasses, 20
absorption of gypsum by bone-black, 100
Anthracen, crude, analysis of, 177, 190, 209
Anthrachinon, preparation of, 42
Anthraquinon, synthesis of derivatives of, by means of phthalic acid, 269
Antimony, sulphide of, accidental use of, 238
Antoine, M. C., certain mechanical properties of saturated steam, 140
Apjohn, R., on a simple apparatus for estimating urea, 36
Arable soils, studies on, 281
Armatures, magnetisation of steel bars fitted with, 129
to magnets, effect produced by the application of, 98
Armstrong, Dr., isomeric change in the phenol series, 182
Aromatic oxy compounds, colouring matters from, 31
sulphines, 42
Arsenic, preparation of magenta without, 141
"Artificial Colours, Testing of" (review), 29
Assay of iron ores, stannous chloride as a reducing agent in the technical, 63
"Assaying by the Spectroscope, Experiments made in the U. S. Mint" (review), 82
Assays, polarimetric, of beet-root juice, method and tables for, 269
Assimilation of certain nitrogenous substances by plants, 6
Attached water and salt solutions, 49
Attraction and repulsion resulting from radiation, 1, 11, 23, 33, 43, 53, 189, 215
Austen, O. T., certain new nitrodiphenylamins, 41
Axerio, J., report on mineral industry of Italy, 1873, 197
Axmann, Dr., ratio of milk to butter, 207

BACTERIA for oxygen, 218
Baeyer, M. A., history of eosin, 269
and Caro, H., synthesis of the derivatives of anthraquinon by means of phthalic acid and the derivatives of benzin, 269
Bands in primary spectra, distribution of, 8
Bannow, A., preparation of gaseous hydriodic acid, 130
Bardy, C., flame of sulphur, and on divers lights useful in photography, 99
and A. Riche, detection and determination of methylic alcohol in presence of vinous alcohol, 239
Barium, metallic, preparation of, 243
Barometer, chameleon, 118
Barral, J. A., and R. Duval, influence of sampling manures upon the results of analysis, 207
Bastie, A., glass hardening or tempering to resist blows and heat, 174
tempered glass, and on its resistance to blows and to heat, 261
Baudrimont, M. A., experiments and observations on the viscous fermentation, 280
Baumann, E., compound of sarkosin and guanidin, 32
Baumgarten, G., elasticity of rods of calcareous spar, 72
Baumstark, F., peculiar formation of a compound of ethyliden, 35
two pathological colouring matters in urine, 41
Bayer, A., nitroso-benzol and nitroso-naphthalin, 151
Béchamp, M. A., matters optically active and distinct from glucose, normally present in wine, 217
remarks concerning a paper by M. Gayon, on the spontaneous decomposition of eggs, 281
Beckett, G. H., and Wright, C. R. A., action of organic acids and their anhydrides on the natural alkaloids, 37, 256
action of organic acid upon the natural alkaloids, 261
notes on the sulphates of narceine and other narceine derivatives, 256
on narcotine, cotarnine, and hydrocotarnine, 181
Becquerel, M., fourth memoir on electro-capillary actions, and on the intensity of the forces by which they are caused, 172

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Becquerel, M., intervention of physico-chemical forces in vital phenomena, 19
new researches on the mode of intervention of electro-capillary forces in the phenomena of nutrition, 140
results produced by the joint action of a battery and of electro-capillary currents, 19
Bees, ferment in, in bee-bread, and in pollen, and on certain ingredients of honey, 207
Beet-root, sugar, 196
manure for, 262
Beetz, W., electrolytic preparation of magnets, 73
Behaviour of alcohol-yeast in media free from oxygen, 31
Behr, A., intensity of the inversion of sugar by various mineral and organic acids, 218
Beilstein, F., chlorinised phenyl-mustard oil and its derivatives, 130
connection of substituted benzols and phenols, 110
Beketoff, M. N., action of hydrogen upon nitrate of silver, 30
Bel, J. A., relations which exist between the atomic formulæ of organic bodies and the rotatory power of their solutions, 9
Bell, C. A., action of reducing agents upon nitranilides of salicylic acid, 244
Belleville, Kildal, Ekstrand, Moser, and Dirks, quantity and quality of milk of cows of different breeds and strains, 281
Benson, P. P., action of anhydrous ether on titanium tetrachloride, 65
Benzamide into aldehyd and benzoic alcohol, transformation of, 21
Benzol, ammonia derivatives of, 61
Berthelot, M., action of heat on ordinary aldehyd, 240
certain problems of molecular mechanics, 161
detection of ordinary alcohol mixed with wood spirit, 238
moderated oxidation of the carbides of hydrogen: amylen, 40
on carbonyles, a new class of organic compounds, and on the true function of ordinary camphor, 174
researches on the fatty acids and their alkaline salts, 269
stability of salts of fatty acids in presence of water, and on reciprocal displacement of acids, 185
Betelli, C., detection of amylic alcohol in spirit of wine, 197
Bibanow, M., preparation of magenta without arsenic, 141
Biedermann, R., forty-seventh meeting of German naturalists and physicians, held at Breslau, Sept. 18 to 24, 1874 (chemical section), 130
Birnbaum, M., quantity of neutral fatty bodies remaining in fats after saponification, 141
Bischoff, C., compounds of the urethans with aldehyds, 31
Black aniline, 99
Blanshard, C. T., nature and constitution of camphor and phorone, 111
Blavier, M. E., observations on a recent communication by M. Volpicelli on the electric influence, 30
Bleaching-powder, action of dilute mineral acids on, 268
processes, new, 185
Bobierre, A., ebullition of sulphuric acid, 208
inaccuracy of determinations of nitrogen in manures, 204
Bock, M. and C. A., decomposition of neutral fatty bodies, 250
Boillot, M. A., decolourising property of ozone, 250
Boireaux, G., and Léger, E., use of the oils in coal in the preparation of the alkaloids, 261
Boisbaudran, M. L., unequal solubility of different surfaces of the same crystal, 229
Boivin, E., influence of boiling distilled water upon Fehling's test, 9
Bone-black, absorption of gypsum by, 100
Bones, buffalos, analysis of, 218
Bondonneau, M. L., amylogen or soluble starch, 172
pure dextrin from malt, 182
saccharo-carbonate of lime and hydrated carbonate of lime, 185
Bong, G., certain purple colouring matters derived from cyanogen, 239
Böttger, M., formation of ozone during decomposition, and formation of water, 207
Bottomley, J., case of reversed chemical action, 76
Bouchardat, M. G., specific rotatory power of mannite, 72
Boucherie, M., use of carbolic acid in preparing timber, 208
Bouhy, M., production and consumption of coal, 197
Bourgeois, A., and Schützenberger, P., carbon of white cast-iron, 207
Bourgoin, E., action of chlorine on perbromide of acetylen, 140
perbromide of bromated acetylen, 174, 261
preparation of perchlorated ethylen, 217
Boussingault, M., limit of the carburation of iron, 206
observations on the use of the tincture of guaiacum as a test for the purity of kirschwasser, 281
Boutin, A., large quantities of nitrogen in two varieties of Amaranthus, 208
Bouty, E., quantities of magnetism, and on the position of the poles in slender needles, 206
Brackebusch, M. A., certain new bleaching processes, 185
Braham, P., dissociation of nitric acid, 112, 140
Brain, chemical constitution of the, 112
Braithwaite, J., and W., "Retrospect of Medicine" (review), 59
Bread, detection of alum in, 66
"Bread-Stuffs" (review), 171
Brefeld, O., remarks on M. Traub's communication "on the behaviour of alcohol-yeast in media free from oxygen gas," 31
Brodie, Sir B. C., synthesis of methyl-aldehyd, 61
Bromide, nitrosyl-, and on sulphur bromide, 276
Bromine, action of on aldehyd, 130
Brown, C., agricultural chemistry of the tea plantations of India, 256
minimum of solids in milk, 266
Bronzes of Japan, 229
Brugnatelli, T., and Pelloggio, P., action of sulphur upon water and upon carbonate of lime, 197
Brüning, M., production of aniline colours without the use of arsenic acid, 83
Bultman, M., account of an experiment on oats with different manures, 207
Burgsorf, F., influence of quality of seed upon the crop, 208
CAHOURS, M. A., researches on the sulphines, 280
Cailletet, M. L., hydrogenised iron, 119
influence of pressure upon combustion, 149
Calcareous spar, elasticity of rods of, 72
Calcic hypochlorite from bleaching-powder, 113
Caliche, or native sodium nitrate, 263
Calorimetric study on the carbides of iron and of manganese, 217
Cabot, S., decomposition of salt by superheated steam, 243
Camacho, M., electro-magnet with concentric tubes, 119
Cambrian rocks, occurrence of phosphates in, 202
Cambridge coprolite, analysis of, 209
Cameron, C. A., manual of hygiene, public and private, 96
note on M. Ville's experiments showing the assimilation of certain nitrogenous substances by plants, 6
some points in the chemistry of milk, 54
Camphines, 269
Camphor, certain monatomic sodic alcohols upon, 239
nature and constitution of, 111
Cannizaro, S., meta-santonin, 21
Carbo-hydrates, 110
Carbon of white cast-iron, 207
sulphide of, 269
Carbolic acid, preparation of colourless crystalline, 141
test for, 64
Carbonate, ammonio-silver, 231
Carbonic acid, determination of by Schiebler's apparatus, 253
in carbonates, 186
in the air, determination of on board the balloon "Zenith," 217
supposed emission of from the roots of plants, 218
Carbides of iron and manganese, calorimetric study of, 217
Carnelley, T., analysis of one of the Trefriw mineral waters, 27
note on the effect of passing the mixed vapours of carbon bisulphide and alcohol over red-hot copper, 38
Caro, H., and A. Baeyer, synthesis of the derivatives of anthraquinon by means of phthalic acid and the derivatives of benzin, 269
Carpeni, A., determination of tannin, 282
Casali, A., economical chrome green, 197
Caustic soda, manufacture of, 87, 103, 121, 134
Cement for marble and alabaster, 185
Chalk as a source of heat, 61
red, and red clay, 199
Chalkosiderite and Andrewsite, 213
Chamber crystals, 31
Chameleon barometer, 118
as a hygrometer, value of the so-called, 88
Champion, P., decomposition of Fehling's liquid; determination of glucose in presence of sugar, 84
equivalence of alkalies in beet-root, 229
Chautard, M. J., action of magnets upon rarefied gases enclosed in capillary tubes illuminated by an induced current, 250
Chemical action, reversed, 76
arts, development of in the last ten years, 203, 221, 231, 243, 255, 262, 273
constitution of the brain, 112
ferments, 280
Society, 83
Chevreul, M., procedures of the human mind in the investigation of the unknown by aid of observation and experiment, 185
Chlorides, electrolysis of certain metallic, 49
of alcoholic radicals on the secondary monamines, 140
Chlorine gas, manufacture of, 263
action of on acetamide, 276
on perbromide of acetylen, 140
on pyrogallol, 253
Chloroform, reactions of metallic sodium on, 121
"Cholera, How to Prevent and Resist it" (review), 139
Chrome alum, molecular equilibrium of solutions of, 40
solutions of, 19
green, economical, 197
salts of, certain reactions of, 269
Chrustchoff, P., contributions to the knowledge of ethyl-phenol and ethyl-benzol sulphonic acids, 41
Chrysen and pyren, fluorescence between, 219
fluorescent relations of, 25, 45
Church, A. H., note on silver alum, 223
red chalk and red clay, 199
short notices of some Cornish minerals, 153
Churchill, J. F., "Consumption and Tuberculosis; Proximate Cause and Specific Treatment by the Hypophosphites" (review), 184
Cinnabar, quantitative analysis of, 266
Citric and tartaric acids, 274
Claus, E. A., dioxyquinon of chrysen, or chrysocyanin, 269
Clève, M. P. T., compounds of cyanide of mercury with the sulphocyanides, 173
Swedish correspondence, 9
Cloizeaux, M., pyroxenic constituent of the rock associated with platinum in the Ural, 1
Clays, red, and red chalk, 199
Coagulation of albumen, 51
Coal and coke, sulphur in, 261
in Russia, 133
Coal-tar colours, means of distinguishing, 229
Coals, use of oils in the preparation of alkaloids, 261
Cœrulignon, 269
Coke-manganese galvanic cell, 2
Coleman, J. J., methods in use for testing hydrocarbon illuminating oils, 147
J. T., effects of pressure and cold upon the gaseous products of the distillation of carbonaceous shales, 256
Collas, C., hydrated gelatinous phosphate of lime and its industrial applications, 208
Collas, G., decolourising properties of phosphate of lime, 2
Collodion, physical properties of plates of, 206
Colouring matters from aromatic oxy-compounds, 31
Colour in water, estimation of, 113
manufactory, explosion at, 22
of vermillion, degradation of by contact with copper and brass, 89
Combination of hydrogen with metals, heat disengaged by, 3
Commercial analyses, 8
"Commercial Handbook of Chemical Analysis" (review), 248
Condensation radicals, study of, 47
Conductivity, electric, of glass, 26
Constituents, natural, of wine, 125
Constitution of torbanite, 76
"Consumption and Tuberculosis their Proximate Cause and Specific Treatment by the Hypophosphites" (review), 184
Converting sulphate of soda, new process for, 22

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Copper, combination of grape sugar with, 261
glucosate of, 218
in aerated waters, presence of, 77
ores, treatment of, 168
presence of in the human organism, 99
solutions of sulphate of, regarding their influence on the germinating powers of wheat, 208
Coprolite, Cambridge, analysis of, 209
Coquillion, J. J., action of platinum and palladium upon the hydrocarbides of the benzinic series, 239
Corael, J., dissociation of methyl-aniline violet, and its separation into two colours under the influence of certain normal and pathological tissues, and by tissue in a state of amyloid degeneration, 268
Cornu, M. A., determination of the speed of light and of the solar parallax, 30
Cotarnine, 181
Coumarin, metallic derivatives of, 257
"Creation, the Origin of, or the Science of Matter and Force" (review), 38
Crombie, J. M., introduction of sleep and insensibility to pain by the self administration of anæsthetics, 19
Crookes, W., attraction and repulsion resulting from radiation, 1, 11, 23, 33, 43, 53, 189, 215
Crucibles in gas furnaces, new method of supporting, 214
Crude anthracen, analysis of, 177, 190, 209
Crystals, lectures on the morphology of, 3, 13, 24, 63, 101, 111, 121, 153, 200, 232
Cupric chloride, action of on mercuric sulphide, 110
Cutie, P., "Des Produits, tires du Pin Maritime, Essai theorique et practique sur la Fabrication des Matieres Resineuses" (review), 7
Cymen-carbonic acid, production of, 218

DANA, J. D., doubtful minerals, 160
Davis, G. E. and T. H., analysis of crude anthracen, 177, 190, 209
Daubrée, M., association in the Ural of native platinum with rocks having a basis of peridote, and the relation of origin which unites this metal with chrome iron, 185
experiments on the artificial imitation of native magneto-polar platinum, 161
David, M., observations on urines which reduce Fehling's test-liquid but do not deflect the polarimeter, 240
Debray, H., ruthenium and its oxygenated compounds, 150
Decomposition and preservation of wood, 60
of certain salts by water, 8
of neutral fatty bodies, 250
of salt by superheated steam, 243
of salts, time required for double, 266
Deering, W. H., examination of water by the ammonia method, 333
Debérain, P. P., and M. Fremy, researches on sugar beet-root, 196
Demole, M. E., rectification, 51
Dewar, A., "Origin of Creation, or the Science of Matter and Force" (review), 38
Depth and superposition of the magnetized layers in steel, 140
Deprez, M., researches on the rapidity of magnetism and demagnetisation of iron, cast-iron, and steel, 281
Derivatives, metallic, of coumarin, 256
of thymol, natural and synthetic, 218
Descampe, concessibility of iron mines, 197
Determination of carbonic acid in the air, on board the balloon "Zenith," 217
Deville, M. H. Sainte-Claire, alloys of platinum and iron, 172
ruthenium and its oxygenated compounds, 150
Dextrin from malt, 182
Dibrom-acetic acid, 65
Di-iso-propyl-aceton, 109
Dirks, Kildal, Elstrand, Moser, and Belleville, quantity and quality of the milk of cows of different breeds and strains, 281
Dissociation of nitric acid, 140
Distillation of ammonia in presence of sulphocyanides, 15
Ditte, M. A., decomposition of certain salts by water, 8
determination of boracic acid, 150
solubility of nitrate of soda, and its combination with water, 250
Double sulphate of silver and aluminium, 209
Doubts in regard to the law of the diffusion of gases, 6
"Drainage, Advantage of a Separate System of" (review), 237
Duclaux, E., volatile acids of wine, 208
Ducretet, M. E., electro-chemical resistance of aluminium used as the positive electrode of a voltameter, 99
Dumas, M., use of alkaline sulpho-carbonates against the phylloxera, 239
Dupré, A., alkaloid body in the organism, 130
note on the natural constituents of wine, 125
Durassier and Trève, MM., relation between the nature of steels and their coercitive force, 196
Duval, R., and J. A. Barral, influence of sampling manures upon the results of analysis, 207
Dyes, new, 75
Dynamical evidence of the molecular constitution of bodies, 97

EBULLITION, intermittent, 177
Elasticity of rods of calcareous spar, 72
Electric conductivity of glass, 265
currents of high tension, researches on the phenomena produced in liquids by, 250
influence, observations on a recent communication by M. Volpicelli on the, 130
light, new way of producing, 119
Electricity, 22
of mineral springs, 270
Electrolytic oxygen upon methylic alcohol, 99
on vinic alcohol, 72
Electrolysis of certain metallic chlorides, 49
Electro-deposition of iron, 137
Elstrand, Kildal, Dirks, Moser, and Belleville, quantity and quality of the milk of cows of different breeds and strains, 281
Engel, M. R., characters of glycocoll, 250
substitution of mercury for hydrogen in creatin, 207
Eosin, 251, 269
Erdmann's floats, improvements in, 262
Erlangen, communications from the laboratory of, 186
Erlenmayer, M., and Von Planta, ferments in bees, bee-bread, and in pollen, and on certain ingredients of honey, 207
Eschka, M. A., determination of sulphur in coal and coke, 261
Esilman, A., distillation of ammonia in presence of sulphocyanides, 15
Etard, M. A., certain reactions of the salts of chrome, 269
Ether, anhydrous, action of on titanium tetrachloride, 65
Ethyl-benzol-sulphonic acids, 41
Ethyl-toluol, 130
Ethyl-phenol acids, 41
Ethyl-ether and its chlorinated derivatives, 245, 264
Ethylen, perchlorated, preparation of, 217
Evaporation from certain organs of plants, 218
Experimental physics, 247
Explosion at a colour manufactory, 22
Explosive matters, new class of, 9
Eye, defects in the human, as regards achromatism, 170

FATS, determining the fusing-points of, 205, 216, 227, 228, 238
Fatty acids and their alkaline salts, 269
stability of the salts of in presence of water, 185
bodies, neutral decomposition of, 250
matter of wool, composition of, 26
Fassbender, A., communication, 30
Fautrat, L., and A. Sartiaux, influence of forests upon the rainfall of a country, 207
Fehling's liquid, decomposition of, 84
Ferment, diastatic and pepton-forming, in the seeds of tares, 129
Fluorides in the manufacture of glass, use of, 100
Ferrocyanide of aniline with aniline black, 173
"Testing of Artificial Colours" (review), 29
Fischer, M. E., action of concentrated sulphuric acid upon cœrulignon and hydro-cœrulignon, 269
Fleming, J. A., new contact theory of the galvanic cell, 107
Fliche, P., and L. Grandeau, influence of the chemical constitution of a soil upon the growth of the chesnut, 207
Fluorescence between chrysen and pyren, 219
"Fog, Peculiar, seen in Iceland" (review), 184
Fontaine, M. H., electro-dynamic machine, 282
"Food and Drugs Act, Sale of," 90, 95, 104, 125
Fordos, M., rapid process for the detection of lead in the tin lining of vessels, 196
Formation of torbanite, 16
Formic acid, new method of preparing highly concentrated, by means of dehydrated oxalic acid and polyatomic alcohol, 280
and acetic acids, mutual displacement of, 251
Foster, G. C., lines of flow and equipotential lines in a uniform conducting sheet, 113
Fouqué, M., nodules of wollastonite, pyroxene fassite, garnet melanite in the lavas of Santorino, 172
Fox, C. B., "Disposal of Slop Water of Villages" (review), 195
Fox, C. B., "Water Analysis as it should and as it should not be performed by the Medical Officer of Health" (review), 148
Franchis, G. A., and G. Pisati, expansion of phosphorus, 197
Fraser, T. R., "Origin of Creation, or the Science of Matter and Force" (review), 38
Fremy, E., and P. P. Debérain, researches on sugar beet-root, 196
Fresenius, R., analysis of ores of nickel and cobalt, 261
Fritz, H., periodicity of hail, 281
Fuchs, C. W. C., "Practical Guide to the Determination of Minerals by the Blowpipe" (review), 216
"Fuel, Air as" (review), 59
Fungi, functions of, 84
nutrition of, 208
Funke, S. W., sub-soil manuring, 207
Fusing-points of fats, determining the, 205, 226, 227, 228, 238
Fusion-point and thermometry, 234

GALVANIC cell, new contact theory of the, 107
Galvanoscope, electro-medical, 185
Garside, T., laboratory notes, 245
Gas hydrometer, 40
supply of Metropolis, 51
Gases enclosed in coals from the South Wales basin, and the gases evolved by blowers, and by boring into the coal itself, 181
rarefied, action of magnets upon, enclosed in capillary tubes, and illuminated by an induced current, 250
some doubts in regard to the law of diffusion of, 6
theory of, 22
Gastric juice, source of acid in, 213
Gatehouse, J. W., dissociation of nitric acid, 112
Gaugain, J. M., on magnetism, 118
theory of processes for magnetisation, 185
Gayon, U., observations on the spontaneous alteration of eggs, 239
Gille, M., Cousin's parachute, 197
Gérardin, M. A., alteration of the Seine from November, 1874, to May, 1875, 280
Gernez, M. D., analogies between the escape of gases from supersaturated solutions, and the decomposition of certain explosives, 60
solutions of chrome alum, 19
Gentisin, 110
Gill, T., extraction of silver from cupreous iron pyrites, 165
Girard, M., and V. Luynes, rotary power of crystalline sugar and sampling of sugars submitted to polarimetric analysis, 281
remarks on certain qualities of the nitrate of methyl, 173
micrographic study on the manufacture of paper, 172
action of the chlorides of alcoholic radicals on the secondary monamines, 140
comparative study of gums and mucilages, 150
Girouard, E., electrolytic apparatus of M. Louis Maiche, 208
resistance and faults of construction in batteries; platinised contacts, 174
Gladstone, J. H., and A. Tribe, decomposition of water by the joint action of aluminium and aluminium iodide, bromide, and chloride, including instances of reverse action, 276

Gladstone, J. H., and A. Tribe, on the electrolysis of certain metallic chlorides, 49
researches on the action of the copper-zinc couple on organic bodies, 157
time required for the double decomposition of salts, 266
Glass, electric conductivity of, 265
use of fluorides in the manufacture of, 100
Glässen, J., amount of water in walls, and on its quantitative determination, 207
"Glover's tower" action of in the manufacture of sulphuric acid, 85
Glucosate of copper, 218
Glycerin crystals, 73
in wines, 186
Glycocoll, characters of, 250
Glyoxylic acid, 65
Godeffroy, R., new property of glycerin, 135
Gorup-Besanez, J., presence of a diastatic and pepton-forming ferment in the seeds of tares, 129
Gottingen, communications from the laboratory of, 50
Gouvenain, M., sulphuration of copper and iron after a prolonged immersion in the hot spring of Bourbon l'Archambault, 269
Grabowsky, N., action of nitric acid upon normal butyl sulphide, 163
properties of normal sulphobutyric acid and its salts, 163
Gramme's magneto-electric company, 51
Gramp, F., quantitative analysis of cinnabar, 266
Grandeau, L., and P. Fliche, influence of the chemical constitution of the soil upon the growth of the chestnut, 207
Grape-sugar with copper, combination of, 261
Grete, A., and M. Zœllner, use of xanthate of potash against the phylloxera, 281
Green, economical chrome, 197
Griffin, C., new method of supporting crucibles in gas furnaces, 214
Grimaux, M. E., pyruvic ureides; synthesis of parabanic acid, 40
researches on the uric acid group, 196
ureides of pyruvic acid, synthesis of a homologue of allantoin, 19
Gripon, E., physical properties of plates of collodion, 206
Gris d'aniline or nigrosin in silk dyeing, 251
Grodzki, M., communication on raw and pure wood-spirit, 130
Grote, A., levulic acid formed during the action of sulphuric acid upon sugar, 109
Groves, C. E., and J Stenhouse, action of chlorine on pyrogallol, 254, 257
Guanidin and sulph-urea, 49
Guardia, J. M., natural philosophy in England and in France, 10
Guareschi, J., transformation of benzamide into aldehyd and benzoic alcohol, 21
"Guide to the Determination of Minerals by the Blowpipe" (review), 216
Gypsum absorbed by bone-black, 100

HABERLAND, F., solutions of sulphate of copper as regards their influence on the germinating power of wheat, 208
Habets, A., rotatory puddling furnace of Mr. Crampton, and Bessemer steel works, 197
Hæmoglobin, influence of the alkaloids on certain properties of, 109
Hagemann, M., use of fluorides in the manufacture of glass, 100
Hail, periodicity of, 281
Hall, T. W., sun and earth as great forces in chemistry, 127
Hartley, W. N., simple method of determining iron, 113
Hautefeuille and Troost, MM., manganiferous cast-iron, 207
calorimetric study on the carbides of iron and of manganese, 217
dissolution of hydrogen in metals, and on the decomposition of water by iron, 196
Hayes, A. A., wide diffusion of vanadium, and its association with phosphorus in many rocks, 166
Heat, cause of solar, 180
chalk as a source of, 61
disengaged by the combination of hydrogen with metals, 8
on iodide of silver, 4
Hees, van, M., steam-boiler accident due to the extraordinary thinness of sheet-iron, 197
Heisch, C., method of taking the melting-point of fats, 227
Hemisulphide of copper, behaviour of with solution of nitrate of silver, 72
Heumann, K., certain compounds of the sulphide of mercury, 109
degradation of the colour of vermillion, occasioned by contact with copper and brass, 89
Hertfell and Moffat spas, analysis of, 15
Hesse, O., behaviour of solutions of certain substances with polarised light, 186
Hessert, J., analysis of the sulphuretted water of Ber Keraui in the Lybian Desert, 262
determination of the carbonic acid in carbonates, 186
Hicks, H., occurrence of phosphates in the Cambrian rocks, 202
Hinrichs, M. G., determination of the boiling-points of the chlorinised derivatives of toluen, 185
Hinze, H., interesting oxidation of metallic aluminium, 130
Hlasiwetz, H., anhydrous phloroglucin, 50
gentisin, 110
Hodges, Prof., composition of tea from Cachar, 208
Hoff, B., use of kaolin as a clarifying agent, 208
Hoff, J. W. J., structural formulæ in space, 270
Hofmann, W. A., facts bearing on the history of beech-wood tar, 269
on cœrulignon, 269
on eosin, 261
on mesidin, 261
report on the development of the chemical arts during the last ten years, 203, 221, 231, 243, 255, 263
Homersham, S. C., filtered Thames water, and spring water from chalk strata, 282
Holdefleiss, F., solution of phosphorite by admixture in composts, 281
Holland, Sir H., "Fragmentary Papers on Science and other Subjects" (review), 237
Homologue of allantoin, synthesis of a, 19
How, H., some Nova Scotian triassic trap minerals, 234
Howorth, H. H., some doubts in regard to the law of the diffusion of gases, 6
Hubert, M. P., extract of indigo, 164
Hubermann, J., gentisin, 110
Hübner, H., communications from the laboratory of the university of Göttingen, 50
Hughes, J., note on analysis of Cambridge coprolite, 209
Human organism, copper in the, 99
Hydriodic acid, gaseous, preparation of, 130
Hydrocotarnine, 181
Hydrogen, dissolution in metals, 196
"Hydrometry, Handbook of" (review), 172
"Hygiene, Manual of, Public and Private" (review), 96
Hygrometer, value of the so-called chameleon barometer as a, 88
Hypochlorates, $C_{10}H_{16}HCl$, isomerism of the, 280
Hyposulphites and sulphites found in sulphuretted springs, 218

"IMPERIAL Mint Report, Osaka" (review), 216
Inaccuracy of determinations of nitrogen in manures, 217
Inconvenience from the use of vessels of Bohemian glass in chemical analysis, 30
Incrustations, boiler, to prevent, 251
Indigo, manufacture of extract of, 29
Inks, aniline, 229
Iodo-phenols, 38
Iodic acid in iodised flames, formation of, 207
Iodised flames, formation of iodic acid in, 207
Iron and platinum, alloys of, 172
and steel. U.S. Board appointed to test, 270
carbon of white cast, 207
carburation of, limit of, 206
electro-deposition of, 137
furnace blown out, crystalline products from, 273
hydrogenised, 119
pyrites, silver from cupreous, 165
sesquioxide of, anomaly of as prepared from meteoric iron, 118, 210
simple method of determining, 113
Isambert, M., precipitation of silver by protoxide of uranium, 239
Isomeric change in the phenol series, 182
Isomerism of the hypochlorates $C_{10}H_{16}HCl$, 280

JACK, W. E., use of stannous chloride as a reducing agent in the technical assay of iron ores, &c., 63
Jacobsen, Dr., aniline black marking-ink, 261
Jacquemin, M. E., toxicological detection of cyanide of potassium in presence of double non-poisonous cyanides, 40
"Jahresbericht uber die Fortschritte auf dem Gebiete der Reinen Chemie" (review), 96
Jamin, J., depth and the superposition of the magnetised layers in steel, 140
effect produced by the application of armatures to magnets, 98
magnetisation of steel bars fitted with armatures, 129
singular case of magnetism, 206
Jani, W., researches on the methods of determining phosphoric acid conducted at the Agricultural Station at Halle, on the Saale, 161
Jannasch, P., chlorinised xylidin obtained from crystalline xylol, 186
Japan, bronzes of, 229
Jeannel, G., and C. Saint-Pierre, reaction of sulphide of carbon, transition of sulphide of carbon into hydro-sulphocyanic acid, 269
Jean, M. F., new method of titration, 173
Jehn, C., interesting oxidation of metallic aluminium, 130
Joannon, A., new procedure for freeing the salt marshes of Southern France from salt, 207
Joffre, M. J., solubility of phosphates, 10
Johnston, G., note on some crystalline products obtained from a blown-out iron furnace, 273
Johnstone, W., analysis of Moffat and Hertfell Spas, collected on the 8th and 12th of October, 1874, 15
of the Airthrey Springs at Bridge of Allan, 88
Jörgensen, use of fluorides in the manufacture of glass, 100
Juice of beet-root, mineral substances contained in the, 90

"KAHLBAUM, C. A. F., Preis-Courant der Fabric für Alcohol Præparate" (review), 96
Kalischer, S., certain Japanese alloys, 32
Kaolin as a clarifying agent, 208
Keene, J. B., "Handbook of Hydrometry" (review), 172
Kern, E., two new foods, 207
S., ammonio-silver carbonate, 231
apparatus for obtaining sulphuretted hydrogen, 198
coal in Russia, 133
coke manganese galvanic cell, 203
double sulphate of silver and aluminium, 209
new method of quantitative analysis of ordinary alloys, 76
preparation of metallic barium, 243
some properties of nitro-glycerin, 153
some reactions of metallic sodium on chloroform, 121
Kielmayer, M. A., aniline black with ferrocyanide of aniline, 173
Kildal, Elstrand, Dirks, Moser, and Belleville, quantity and quality of the milk of cows of different breeds and strains, 281
King, J. F., process for the estimation of colour in water, 153
Kingzett, C. T., action of dilute mineral acids on bleaching-powder, 268
calcic hypochlorite from bleaching-powder, 113
Kistner, A. S., presence of anhydrous sulphuric acid in the gaseous products of the combustion of iron pyrites, 260
Klusemann, O., phenylen-oxamic acid, 41
Knop, W., contribution to the knowledge of arable soils, 221
Kolbe, H., properties of salicylic acid, 229
and E. von Meyer, anti-putrescent action of salicylic acid, 208
Kopfer, F., action of dilute mineral acids on bleaching-powder, 257
Kopp, M. E., chemical products at the Vienna Exhibition, 60, 261, 269
Kræmer, G., communication on raw and pure wood-spirit, 13
Kuhlmann, M. F., jun., mines of pyrites of Wigenoes, Norway, 21
Kurbatow, A., chlorinised phenyl-mustard oil and its derivatives, 130
connection of substituted benzols and phenols, 110

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LABORATORY notes, 55, 245
Ladyguin, M., the electric light, 197
Lalande, M. F., synthesis of purpurin, 88
Lange, V., crystals of glycerin, 73
Langrange, M. P., action of sulphate of ammonia in the cultivation of the beet-root, 172
Lantern, the vertical, 17
Lantier, D., manufacture of chlorine gas, 208
Latschinoff, P., action of ammonia on aceton, 109
Laws of double interior reflection in bi-refringent uni-axial crystals, 8
Lead in aërated water, presence of, 77
in tinned articles, 268
rapid process for the detection of in the tin lining of vessels, 196
Leclerc, M. A., germination of Chevallier barley, 60
Lefort, L., and Paschutin, V., influence of phosphates and of certain gases upon putrefaction, 282
Légor, E., and Boireaux, G., use of the oils of coal in the preparation of the alkaloids, 261
Lemoine, G., chemical equilibrium between gaseous iodine and hydrogen, 196
Lermontoff, J., sulpho-cyan-methylen, 42
Letheby, Dr., metropolitan gas, 186
Leucic acid nitrile, 31
Liebermann, C., colouring matters obtained from aromatic oxy-compounds and nitrous acid, 31
Liebig, retrospective studies on, 229
Liebig's contributions to experimental chemistry, 135
Light, polarised, 267
stratified, 72
Lime, carbonate of, action of sulphur on, 197
hydrated, gelatinous phosphate of, and its industrial applications, 208
phosphate of, of Ciply, in Belgium, 217
saccharo-carbonate and hydrated carbonate of, 185
Limpricht, H., communications from the Griefswald laboratory, 109
Löcher, J., diagnosis of primary, secondary, and tertiary alcohols and alcohol-radicals by colour-reactions, 134
Lodge, J. O., lines of flow and equipotential lines in a uniform conducting sheet, 113
Loiseau, D., influence of boiling distilled water upon Fehling's test, 9
Lorin, M., new method of preparing highly concentrated formic acid by means of dehydrated oxalic acid and a polyatomic, 280
Lorenz, F. C., preparation of stilben and certain of its compounds, 31
Louguinine, M. W., correspondence from St. Petersburg, 9, 251, 270
study of the amounts of heat liberated in the formation of the potash salts of certain acids of the fatty series, 161
Luca, M. S. de, chemical researches on the absorption of the ammonia of the atmosphere by the volcanic earth of the Solfatara of Pouzzoli, 173
Lucius, M., production of aniline colours without the use of arsenic acid, 83
Lunge, Dr., manufacture of sulphuric acid in England, 177
Luynes, V., and Girard, A., rotary power of crystalline sugar, and on the sampling of sugars submitted to polarimetric analysis, 281
Lyte, M. F., volumetric estimation of zinc, 222

MACAGNO, J., volumetric process for the determination of phosphoric acid, 197
Machattie, A. T., accidental use of sulphide of antimony, 238
native sodium nitrate, or "caliche," 263
M'Leod, H., some observations on the defects of the human eye, as regards achromatism, 170
Maercker, M., researches on the methods of determining phosphoric acid, conducted at the Agricultural Station at Halle, on the Saale, 161
Magenta without arsenic, preparation of, 141
Magnetic anomaly of sesquioxide of iron, prepared from meteoric iron, 118
Magnetisation, a singular case of, 206
Magnetism, 59, 118, 119
new source of, noticed by M. D. Tommasi, 228, 250
Magnets, action of upon rarefied gases enclosed in capillary tubes and illuminated by an induced current, 250
effect produced by the application of armatures to, 98
electrolytic preparation of, 73
Mallet, J. W., achrematite, a new molybo-arseniate of lead from Mexico, 276
certain new reactions of tungsten, 276
Maltose, 30
Maly, F., formation of paralactic acid by fermentation, 151
Manganese and carbides of iron, calorimetric study of, 217
Mannite, specific rotatory power of, 72
Manthner, J., behaviour of neurin with albumenoids, 131
"Manual of Hygiene, Public and Private" (review), 96
Manufacture of superphosphate, new apparatus for the continuous, 250
Manure for beet-root, 262
Manurial experiments on the field at Giessen, 218
Maquenne and Millot, MM., ammoniaco-magnesian phosphate, 240
Marking-ink, aniline black, 261
Maskelyne, N. S., andrewsite and chalkosiderite, 213
lectures on the morphology of crystals, 3, 13, 24, 63, 101, 111, 121, 153, 200, 232
"Materia Medica, Journal of" (review), 7
"Matter and Force, Science of" (review), 38
Matters optically active, distinct from glucose, normally present in wine, 219
Maumène, E. J., apparatus for the measurement of gases in industrial analyses, or gas-hydrometer, 40
determination of glycerin and succinic acid in wines, 186
note on the bronzes of Japan, 229
"Medicine, Retrospect of" (review), 59
Menström, M. S., electric discharge in the aurora borealis, and the spectrum of the same phenomenon, 119
Mercadante, M., behaviour of tannic acid in cultivated soils, 21
Mercury, sulphide of, certain compounds of, 109
Mermé, M., new body found in the urine after the ingestion of chloral hydrate, 217
Metallic barium, preparation of, 243
Meta-santonin, 21
Methods for effecting the quantitative separation of iron sesquioxide, alumina, and phosphoric acid, 214
Methyl aldehyd, 186
synthesis of, 61
green on wool, 251
iso-propyl-keton, 109
nitrate of, 173
Methylic alcohol, detection and determination of in presence of vinous alcohol, 239
electrolytic oxygen upon, 99
Metropolitan gas, 186
Meusel and Pick, MM., newly-discovered beds of phosphorite in Austria, 207
Meyer, V., diagnosis of primary, secondary, and tertiary alcohols and alcohol-radicals by colour reactions, 134
von E., and Kolbe, H., anti-putrescent action of salicylic acid, 208
Michaelis, A., constitution of "chamber crystals," 31
Milligrade thermometric scale, 214
Millot, A., and Maquenne, MM., ammoniaco-magnesian phosphate, 240
Mills, Dr., fusion-point and thermometry, 234
Milne, J., presence of lead and copper in aërated waters, 77
Mineral springs, electricity of, 270
substances contained in the juice of beet-root, 98
Minerals, doubtful, 107
on some Nova Scotian triassic trap, 234
Milk, analysis of, 78
decomposition of, 106
Dr. Brown's paper on, note on, 279
in health and disease, 232
minimum solids in, 266, 280
some points in the chemistry of, 54
Mitscherlich, A., observations on the combustion-point, 170
Moffat and Hertfell spas, analysis of, 15
Mohr, Dr., precipitation of magnesia, 261
Molasses, formation of, 20
Molecular constitution of bodies, dynamical evidence of the, 97
equilibrium of solutions of chrome alum, 40
Monatomic sodic alcohols upon camphor, 239
Monazite and xenotine, 174
Moncel, Th. du, magnetism, 161
note on magnetism, in reference to a recent communication of M. Lallemand, 59
Mono-phospho-guano and Peruvian guano, experiments with, 218
Monson, E., "Advantages of the Separate System of Drainage" (review), 237
Moore, S. W., new process for preserving wood from fire and decay, 75
obituary notice of, 251
Morin, M. J., new electro-medical galvanoscope, 185
Morphine and codeine and their derivatives, rational formulæ of, 71
Morphology of crystals, lectures on the, 3, 13, 24, 63, 101, 111, 121, 153, 200, 232
Morrison, J., manufacture of caustic soda, 87, 103, 121, 134, 144, 155
Morton, H., fluorescent relations of chrysene and pyrene, 35, 45
Moser, J., manufacture of fœcal manures at Graz, 207
Kildal, Elstrand, Dirks, and Belleville, MM., quantity and quality of milk of cows of different breeds and strains, 281
Moutier, M. J., heat disengaged by the combustion of hydrogen with metals, 8
Mud, analysis of, taken from the Mer Rouge at low water, 274
Muir, M. M. P., on nitrosyl bromide and on sulphur bromide, 276
Mulder, E., on cyanamid, 151
the law of multiple deviations, 50
Müller, W., reduction of metallic oxides by hydrogen, and application to the detection and quantitative determination of metals, 143
Multiple deviations, law of, 50
Münde, R., di-iso-propyl-keton and methyl-iso-propyl-keton, 109
Müntz, M., functions of fungi, 84
M. A., chemical and physiological ferments, 280
Musculus, M., new body found in the urine after the ingestion of chloral hydrate, 217
Mutual displacement of acetic and formic acids, 251

NARCEINE sulphates and other narceine derivatives, 256
Narcotine, 181
Native sodium nitrate, or caliche, 263
Natural philosophy in England and France, 10
Naumann, A., dissociation of sulphate of copper, 151
Nigrosin or gris d'aniline in silk dyeing, 251
Niederstadt, B. C., Estremadura phosphorite, 144
Ninoit, M., phosphate of lime of Ciply, in Belgium, 217
Nitrate of soda, solubility of, and its combination with water, 250
Nessler, J., detection of adulterated wines, 281
test, action of on rain water, 263
Nencki and Schenck, MM., influence of muscular exertion on the secretion of urea, 207
Neurin with albumenoids, behaviour of, 131
Neutral fatty bodies, decomposition of, 250
remaining in fats after saponification, 141
Neyreneuf, M., stratified light, 72
Nilson, M. F., researches on the selenites, 251
Nitranilides of salicylic acid, action of reducing agents upon, 244
Nitrate, sodium, native, or caliche, 263
Nitric acid, dissociation of, 112, 140
on copper, mercury, &c., in presence of metallic nitrates, 276
oxides, determination of, 261
Nitro-alizarin, 256
Nitrogen, inaccurate determination of in manures, 204
Nitrous acid and peroxide of hydrogen in nature, 217
ether, production of by sulphovinic acid, 75
Norblad, J. N., certain salts of vanadium, 173
Normandy, A., "Commercial Handbook of Chemical Analysis" (review), 248
Nova Scotian triassic trap minerals, on some, 234

OGILVIE, T. R., estimation of phosphoric acid as ammo-magnesian phosphate

Oglioforo, A., action of bromine upon anhydrous chloral, 21
Olley, W. H., polarised light, 267
Ores, copper, treatment of, 168
iron, stannous chloride as a reducing agent in the technical assay of, 63
Organic acids and their anhydrides on the natural alkaloids, 37, 256
Ortho-dinitro-benzol, 109
Ott, A., new dyes of Croissant and Bretonniere, 75
preparation of saffranin, 20
Oxidation, moderated, of the carbides of hydrogen; amylen, 40
of metallic aluminium, 130
Oxygen, need of bacteria for, 218
Ozone, decolourising property of, 290
formation of in the decomposition and formation of water, 207

PAGNOUL, M., part exercised by alkaline salts on the vegetation of the beet-root and potato, 229
Parabanic acid, synthesis of, 40
Paratoluylic nitrile and some derivatives, 218
Paschutin and Lefort, MM., influence of phosphates of certain gases upon putrefaction, 282
Pasteur, M., new observations on the nature of alcoholic fermentation, 208
Patents, 10, 32, 42, 52, 62, 85, 100, 120, 142, 152, 175, 197, 219, 230, 240, 252, 271
Paterno, E., and G. Pisati, measurement of the indices of refraction of cymen, benzol, and some derivatives of natural and synthetic thymol, 197
Pathological colouring matters in urine, 41
Paulet, M., decomposition and preservation of wood, 60
Paykull, S. R., rauite, a new mineral from Brewig, in Norway, 50
Peligot, E., mineral substances contained in the juice of beet-root, and on the potash extracted, 98
Peligot, E., saline matters which the sugar beet-root draws from the soil and from manures, 83
Pellet, H., decomposition of Fehling's liquid; determination of glucose in presence of sugar, 84
equivalence of alkalies in beet-root, 229
Pelloggio, P., and T. Brugnatelli, action of sulphur upon water and upon carbonate of lime, 197
Perbromide of acetylen, action of chlorine on, 140
Perchlorated ethylen, preparation of, 217
Perkin, W. H., nitro-alizarin, 257
on dibrom-acetic and glyoxylic acid, 65
propionic coumarin, and on certain of its derivatives, 261
Peroxide of hydrogen and nitrous acid, formation of in Nature, 217
Perrot, M. E., method and tables for polarimetric assays of beet-root juice, 269
scum from sugar-works, and the danger of their presence near the manufactories, 99
Perry, S. L., magnetic observations made in Belgium in 1871, 197
Persoz, M. J., certain properties of weighted black silks, 61
Peruvian guano and mono-phospho guano, experiments with, 213
Pesier, M. E., conditions of the sugar manufacture, 22
Pettenkofer, M., cholera, how to prevent and resist it, 139
Petersen, T., notice on substituted phenols, 262
"Pharmacy, Year-Book of" (review), 279
Phenol series, isomeric change in the, 182
Phenyl-mustard oil, chlorinised, 130
Phenylen-oxaminic acid, 41
Phorone, nature and constitution of, 111
Phosphate, ammoniaco-magnesian, 240
estimation of phosphoric acid as ammonio-magnesian, 274
of lime, of Ciply, 217
Phosphates and certain gases upon putrefaction, influence of, 282
commercial, and potash salts, 270
occurrence in the Cambrian rocks, 202
solubility of, 10
Phosphoric acid, alumina, and iron sesquioxide, methods for effecting the quantitative separation of, 214
estimation of as ammonio-magnesian phosphate, 274
volumetric process for the determination of, 197
Phosphorite, newly-discovered beds in Austria, 207
Phosphorus, its association with vanadium in many rocks, 166
Phillips, J. A., structure and composition of certain pseudomorphic crystals having the form of orthoclase, 256
S. E., alum type, 268
Chemical Society, 83
study of condensation radicals, 47
Phipson, T. L., intermittent ebullition, 177
new way of observing absorption spectra, 255
production of nitrous ether by means of sulphovinic acid, 75
second note on sulphovinic acid, 103
Phloretic acid, two derivatives from, 218
Phthalic acid, new formation of, 31
synthesis of derivatives of anthraquinon by means of, 269
Physico-chemical forces in vital phenomena, intervention of, 19
Physiological ferments, 280
Pick, S., and Meusel, MM., newly-discovered beds of phosphorite in Austria, 207
Pinner, A., action of bromine upon aldehyd, 130
Pisati, G., and G. Franchis, expansion of phosphorus, 197
and E. Paterno, measurement of the indices of refraction of cymen, benzol, and some derivatives of natural and synthetic thymol, 197
Plaits, H. C., ammonia-soda process, 95
Planta, von, Dr., and Erlenmeyer, M., ferments in bees, in beebread, and in pollen, and on certain ingredients of honey, 207
Planté, M. G., researches on the phenomena produced in liquids by electric currents of high tension, 250
Plants, assimilation of certain nitrogenous substances by, 6
Platinum and iron, alloys of, 172
palladium, action of upon the hydrocarbides of the benzinic series, 239
"Plattner's Manual of Blowpipe Analysis" (review), 270
Plosy, P., peptones and nutrition thereby, 207
Pœhl, A., glucoses in rye- and wheat-flour, 208
Polacci, E., action of sulphur on carbonate of lime, 21
origin of the sulphides and hyposulphides found in sulphuretted springs, 218
Polarimetric assays of beet-root juice, method and tables for, 269
Polariscope, revolving, 234
Polarised light, 267
Post, J., preliminary communications, 50
Potash, simple method for testing for, 231
Potassic iodide, industrial preparation of with the waters used for lixiviating kelp of crude soda, 230
Potash, simple method for testing, 250
Potassium-phenyl-acetate, electrolysis of, 30
Preparation of metallic barium, 243
Prevost, E. W., action of chlorine on acetamide, 276
Priestley celebration at Northumberland, Pennsylvania, 17
Prillieux, E., formation of gum in fruit trees as a pathological phenomena, 208
"Preis-Courant der Fabric für Alcohol Præparate, von C. and F. Kahlbaum, Berlin" (review), 96
Prizes for inventions, 276
Production of cymen-carbonic acid, 218
"Promotion of Scientific Industry, Journal of the Society for the" (review), 128
Proskauer, B., selen-cyan-ethylen and selen-cyan-methylen, 39
Public Analysts, Society of, 58, 66, 78, 90, 104, 114, 125, 137, 148, 158, 170, 182, 194, 204, 215, 224, 235, 247, 257, 266, 277
Purpurin, synthesis of, 85
Puschl, M., theory of gases, 22
Putrefaction, influence of phosphates and certain gases on, 282
Pyrites of Wigsnoes, Norway, mines of, 21
Pyren and chrysen, fluorescence between, 219
fluorescent relations of, 35, 45
Pyrogallol, action of chlorine on, 254, 257
Pyroletor, for the extinction of fire on board ships, 271
Pyruvic acid, ureides of, 19
ureides, 40

QUANTITATIVE analysis of cinnabar, 266
of ordinary alloys, new method of, 76
"Qualitative Chemical Analysis" (review), 59

RADIATION, attraction and repulsion resulting from, 1, 11, 23, 33, 43, 53, 189, 215
Radicals, study of condensation, 47
Radominski, M. F. V. C., artificial production of monazite and xenotime, 174
Rain-water, action of Nessler test on, 263
Ramsay, W., sodium-ethyl-thiosulphate, 213
Rauite, 50
Rarefied gases, action of magnets upon, enclosed in capillary tubes and illuminated by an induced current, 250
Red sanders, use of, 185
Redwood, Dr., analysis of milk, 78
Regulating amount of water in cultivated lands, 217
Reigler, A., geometric demonstration of Zeuner's diagram, 197
Renard, M. A., action of electrolytic oxygen upon methylic alcohol, 99
of electrolytic oxygen on vinic alcohol, 72
Repulsion and attraction resulting from radiation, 1, 11, 23, 33, 43, 53, 189, 215
"Retrospect of Medicine" (review), 59
Reversed chemical action, 76
Ribau, M. J., isomerism of the hydrochlorates, 280
symbols employed to designate the rotatory powers, 51
Rich, W. S., "Analysts' Annual Note-Book" (review), 196
Riche, A., flame of sulphur, and on divers lights useful in photography, 99
and C. Bardy, detection and determination of methylic alcohol in presence of vinous alcohol, 239
Richter, O., chemical constitution of the ethyl-ether and its chlorinated derivatives, 245, 264
Rigo, E., Warner's procedure for the purification of cast-iron, 197
Ribau, J., camphenes, 269
Rinne, A., ortho-dinitro-benzol, 109
Rivers' Pollution Bill, 221
Roberts, W. C., electro-deposition of iron, 137
liquidation, fusibility, and density of certain alloys of silver and copper, 143
Rodwell, G. F., effect of heat on iodide of silver, 4
Römer, H., forty-seventh meeting of German Naturalists and Physicians, held at Breslau September 18th to 24th, 1874 (Chemical Section), 30
report of the Mineralogical and Geological Section, 131
Rosenstiehl, M. A., relations between the different tinctorial principles of madder, and on the part they play in dyeing, 174, 239
Ross, C. D., air as fuel, or petroleum and other mineral oils utilised by carburetting air and rendering it inflammable, 39
Rotatory power of crystalline sugar, 281
Routledge, R., commercial analyses, 8
Russia, coal in, 133

SAFFRANIN, preparation of, 20
Saint Pierre, C., and G. Jeannel, reaction of sulphide of carbon; transition of sulphide of carbon into hydrosulphocyanic acid, 269
Salet, M. G., distribution of bands in primary spectra, 8
formation of iodic acid in iodised flames, 207
Salicylic acid, properties of, 219
Saline matters which the sugar beet-root draws from the soil and from manures, 83
Salkowski, H., contributions to the knowledge of the ammonia derivatives of benzol, 61
Salt, decomposition of by superheated steam, 243
solutions and attached water 49
Salts, time required for double decomposition of, 266
Salvetat, E., procedures for glazing common earthenware, as used by M. Constantin, 174
Sartiaux, A., and L. Fautrat, influence of forests upon the rainfall of a country, 207
Sauer, M. A., method for determining sulphur of general applicability, 269

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Scale, thermometric milligrade, 214
Schenck, F., and M. Nencki, influence of muscular exertion on the secretion of urea, 207
Schiff, U., nature and constitution of tannic acid, 197
Schlœsing, M. A., ammonia of the atmosphere, 84
Schlösing, T., studies on arable soils, 281
Schneider, R., behaviour of the hemisulphide of copper with a solution of nitrate of silver, 72
Schnitzler, M., preparation of colourless crystalline carbolic acid, 141
Schœr, E., remarks on the influence of the alkaloids upon certain properties of hæmoglobin, 109
Schöller, C., aromatic sulphines, 42
Schröder, H., investigations on the volume-constitution of solid bodies, 32
Schultz, M. A., applications of chrome in calico-printing, 269
Schulze, E., composition of the fatty matter of wool, 26
maltose, 30
Schumann, O., constitution of chamber crystals, 31
Schlumberger and Wehrlin, MM., ferro- and ferri-cyanides for aniline blacks, 174
Schulmacher, E., degree of heat at which yeast-cells perish, 208
Schützenberger, M. P., researches on albumen and the albumenoids, 98, 174, 239
special butyric fermentation, 119
and A. Bourgeois, carbon of white cast-iron, 207
"Science and Other Subjects, Fragmentary Papers on" (review), 237
Scum from sugar works, danger of their being near the manufactories, 99
Selenites, researches on, 251
Sestini, F., quantitative determination of the atomic group C_2H_3O, contained in acetyl substitution-products, 21
and G. Del Torre, residues of the olive oil manufacture, and their utilisation as manure, 281
Sesquioxide of iron, alumina, and phosphoric acid, methods for separating quantitatively, 214
anomaly of as prepared from meteoric iron, 210
Sewage irrigation question, 281
Silks, certain properties of weighted black, 61
dyeing, gris d'aniline or nigrosin in, 251
Silva, R. D., action of certain monatomic sodic alcohols upon camphor, 239
Silver alum, 223
ammonium-alum, 280
and aluminium, double sulphate of, 209
from cupreous iron pyrites, 165
iodide of, effect of heat on, 4
nitrate, hemisulphide of copper with solution of, 72
precipitation of by uranic protoxide, 239
Skey, W., notes on the formation and constitution of torbanite, 16
Slawik, T., electrolysis of potassium-phenylacetate, 30
Sleep, induction of, and insensibility to pain by the self-administration of anæsthetics, 19
"Slop-Water of Villages, Disposal of" (review), 195
Smee, A. H., notes on milk in health and disease, 232
Smith, A., "On a Peculiar Fog in Iceland, and on Vesicular Vapours" (review), 184
A. P., chameleon barometer, 118
J. L., laboratory notes, 55
singular anomaly of the sesquioxide of iron as prepared from meteoric iron, 118, 210
Soda, nitrate of, solubility and combination with water, 250
sulphate of, new process for converting, 22
Sodium ethyl-thio-sulphate, 214
metallic, on chloroform, reactions of, 121
nitrate, native, or caliche, 263
Sokoloff, N., action of ammonia on aceton, 109
Solar heat, cause of, 180
Söltoft, F., manufacture of butter from sour or sweet cream, 208
Solubility of nitrate of soda, and its combination with water, 250
of phosphates, 10
Source of the acid in the gastric juice, 218
Spectra, distribution of bands in primary, 8
new way of observing absorption, 255
Sprengel, H., new class of explosive matters, 9
Spring, W., preliminary communication, 151
Springmühl, F., testing of artificial colours, 29
Spottiswoode, W., revolving polariscope, 234
Staedel, W., "Jahrsbericht uber die Fortschritte auf dem Gebiete der Reinen Chemie" (review), 96
reduction of benzo-phenon, 129
Stannous chloride as a reducing agent in the technical assay of iron ores, 63
Steam, saturated, certain mechanical properties of, 140
Steel bars fitted with armatures, magnetisation of, 129
depth and superposition of the magnetised layers in, 140
Steiner, J., simple method of testing for potash, 231
Stenhouse, J., and C. E. Groves, action of chlorine on pyrogallol, 254, 257
Stevenson, T., decompositions of milk, 106
Stewart, G. C., notes upon sugar analysis, 212
Stilben and certain of its compounds, preparation of, 31
Stock, W. F. K., use of stannous chloride as a reducing agent in the technical assay of iron ores, &c., 63
Stoecker, A., "Wildungen: its Baths and Mineral Springs" (review), 238
Stone, W. H., some points connected with wind instruments, 193
Stratified light, 72
Struve, H., coatribution to the history of the phenomena of fermentation, 50
Succinic acid in wines, 186
Sugar analysis, 212, 223, 261
beet-root, 196
saline matters which are drawn from the soil and from manures by, 83
inverted, 250
manufacture, conditions of, 22
Sulphide of antimony, accidental use of, 238
of mercury, compounds of, 109
Sulphides and hyposulphites found in sulphuretted springs, 218
Sulphines, 280
aromatic, 42
Sulpho-cyan-methyl, 42
Sulphocyanides, distillation of ammonia in presence of, 15
Sulphovinic acid, 103
production of nitrous ether by means of, 75
Sulphur beds of the island of Saba, 262
bromide, and nitrosyl bromide, 276
flame of, 99
in coal and coke, 261
upon water and on carbonate of lime, action of, 197
Sulphuretted hydrogen, apparatus for obtaining, 193
water of the Ber Keraui, analysis of, 262
Sulphuric acid, action of "Glover's tower" in the manufacture of, 85
manufacture of in England, 177
concentrated, action of on cœrulignon and hydro-cœrulignon, 269
Sulph-urea and guanidin, 49
"Sun and Earth as Great Forces in Chemistry" (review), 127
Superphosphate, new apparatus for the continuous manufacture of, 250
works of MM. Michelet and Thibault, report given by M Cloëz, 281
Synthesis of methyl-aldehyd, 61
of purpurin, 85

TANNIC ACID, nature and constitution of, 197
in cultivated soils, 21
Tannin, albumen determined by, 141
determination of, 282
with chloride of zinc, 22
Tartaric and citric acids, 274
Tarry matter in the ammonia of commerce, detection of, 250
Temperature of greatest density of water, 217
Tempered and hardened glass, to resist blows or heat, 174
Terreil, M. A., new treatment of commercial nickel so as to obtain a pure sulphate of nickel without the use of sulphuretted hydrogen or of ammonia, 141
Thaer, M., comparative manurial experiments on the experimental field at Giessen, 218
Thames water, filtered, and spring water from chalk strata, 282
Thermometric scale, milligrade, 214
Thermometry and fusion-point, 234
Thomas, J. W., gases in coals from South Wales Basin, and the gases evolved by blowers and boring, 181
Thomson, W., presence of sulphate of copper in water heated in tinned copper boilers, 146
Thudichum, Dr., chemical constitution of the brain, 112
Thury, M., electricity of mineral springs, 270
Thymol, derivatives of natural and synthetic, 218
Tilden, W. A., action of nitrosyl chloride on organic bodies, 157
Time for double decomposition of salts, 266
Tinned articles, lead in, 268
Tissandier, M. G., aërial corpuscles and saline matter in snow, 60
Titration, 173
Tollens, B., levulic acid formed during the action of sulphuric acid upon sugar, 109
Tommasi, M. D., new source of magnetism, 228
Torbanite, formation and constitution of, 16
Torre, G. del, and F. Sestini, residues of the olive oil manufacture, and their utilisation as manure, 281
Trefriw mineral waters, analysis of one of the, 27
Trève, M. A., on magnetism, 119 and M. Duraissier, relation between the nature of steels and their coercitive force, 196
Triassic trap minerals, on some Nova Scotian, 234
Tribe, A., on the electrolysis of certain metallic chlorides, 49
researches on the action of the copper-zinc couple on organic bodies, 157
and J. H. Gladstone, decomposition of water by the joint action of aluminium and aluminium iodide, bromide, and chloride, including instances of reversed action, 276
Tripe, J. W., easy method of taking the melting-point of butter and other fats, 205
Troost, L., calorimetric study on the carbides of iron and of manganese, 217
and P. Hautefeuille, dissolution of hydrogen in metals, and on the decomposition of water by iron, 196
manganiferous cast-iron, 207
Truchot, M. P., inconvenience resulting from the use of vessels of Bohemian glass in chemical analysis, and especially in alkalimetry, 30
Tungsten, new reaction of, 276
Tunner, P. von, on blast-furnaces fed with wood, and used for easily reducible iron ores, 174
Tyndall, J., Address delivered before the British Association assembled at Belfast, 18

URANIUM, new chloride of, 32
protoxide, precipitation of silver by, 239
Urbain, M. V., coagulation of albumen, 51
Urea, a simple apparatus for the estimation of, 36
Ureides of pyruvic acid, synthesis of a homologue of allantoin, 19
Urethans, compounds of with aldehyds, 31
Uric acid group, 196
Urich, A., composition of the fatty matter of wool, 26
Urine, new body found in, after the ingestion of chloral hydrate, 217
two pathological colouring matters in, 41

VALENTIN, W. G., "A Course of Qualitative Chemical Analysis" (review), 59
Vanadium, wide diffusion of, and its association with phosphorus in many rocks, 166
Van't Hoff, M. J., contributions to the history of cyan-acetic acid, 51
Vermillion, degradation of the colour of by contact with copper and brass, 89
Vertical lantern, 17
Viard, E., analysis of sugars, 261
Viedt, C. H., aniline inks, 229
Villedieu, M., influence of moisture on the Phylloxera, 281
Volpicelli, M., statical electricity 262
Volhard, J., methyl-aldehyd and formic acid methylester, 186
Volumetric estimation of zinc, 222
Vohl, M. H., determination of chlorine of the oxides of nitrogen and of the ferrous oxide in commercial iron mordants, 261
Vorster, M., action of Glover's tower in the manufacture of sulphuric acid, 85

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WAGNER, P., experiments on the chemistry of the process of saccharification by means of malt, 281
practical observations on the properties of salicylic acid, 261
Wanklyn, J. A., detection of alum in bread, 66
note on Dr. C. Brown's paper on milk, 279
Warden, C. J. H., analysis of mud taken at low water from the Mer-Rouge, Mauritius, 274
Warington, R., determination of carbonic acid with Schiebler's apparatus, 253
notes on the chemistry of tartaric and citric acids, 275
Water analysis in the Chemical Society, 249
estimation of colour in, 133
regulating amount of in cultivated lands, 217
temperature of greatest density of, 217
Waters, analysis of one of the Trefriw mineral, 27
some points in the examination of by the ammonia method, 233
Watson, W. H., action of Nessler test on rain-water, 263
Wehle, P., utilisation of the waste hydrochloric liquid from the manufacture of bone-glue, 281
Wehrlin and Schlumberger, MM., ferro- and ferri-cyanides for aniline blacks, 174
Weith, W., notices towards a knowledge of sulph-urea and guanidin, 49
Weinhold, A. F., introduction to experimental physics, theoretical and practical, including directions for constructing physical apparatus and for making experiments, 247
Whewell, M., test for carbolic acid, 64
Whitehouse, W., electric conductivity of glass, 265
Wiesner, J., what rays of light decompose chlorophyll in presence of oxygen, 73
Wigner, G. W., adulteration and Adulteration Acts, special reference to the Sale of Food and Drugs Act, 1875, 115
new forms of tubes for collecting air for analysis, 182
Wilde, M., new arrangement for producing the electric light, 119
"Wildungen, its Baths and Mineral Springs" (review), 238
Williams, J., milligrade thermometric scale, 214
Williamson, R., metallic derivatives of coumarin, 257
Wind instruments, some points connected with, 193
Wine, natural constituents of, 125
Winstanley, D., cause of solar heat, 180
Witor, H. F., specific heats of the elements carbon, boron, and silicon, 240
Witz, M. C., volumetric determination of acetates and of acetic acid in presence of mineral acids, 173
Wood, decomposition of, 60
preserving from fire and decay, 75
Wood, W. H., silver-ammonium alum, 280
Wood-spirit, ordinary alcohol mixed with, 238
Wool, composition of the fatty matter of, 26
methyl-green on, 251
Wright, C. R. A., action of the organic acids and their anhydrides on the natural alkaloids, 37
rational formulæ of morphine and codeine and their derivatives, 71
Wright, C. R. A., and Beckett, G. H., action of organic acids and their anhydrides on the natural alkaloids, 256, 261
notes on the sulphates of narceine and other narceine derivatives, 256
narcotin, cotarnin, and hydrocotarnin, 181

XENOTINE and monazite, 174
Xylindein, 31
Xylidin, chlorinised, obtained from the crystalline xylol, 136

YEAST, alcoholic, 27

ZŒLLER, M., and A. Grete, use of the xanthate of potash against the phylloxera, 281
Zinc, chloride of, tanning with, 22
volumetric estimation of, 222
Zincke, T., ortho-dinitro-benzol, 109
Zöller, P., nutrition of fungi, 208

END OF VOLUME XXXI.

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THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE."

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S., &c.

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VOLUME XXXII. 1875.

LONDON:

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THE CHEMICAL NEWS.

VOLUME XXXII.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 814.—FRIDAY, JULY 2, 1875.

THE MONO CHARACTER OF ETHYLEN AND OTHER POLYAMINES.

By S. E. PHILLIPS.

Owing to inveterate preconceptions, it often happens that truth requires a constant reiteration. We have on many occasions referred to the mono character of these amines, and made a formal enunciation, in an enquiry as to certain morphia polymerides (Chemical News, vol. xxxi., p. 47).

Dr. Wright, however, defends the position occupied by *Hof*mann, Odling, and others in the following terms:—

"As a rule, the maximum combining power of such bodies is usually equal to the number of N symbols in their rational formulæ, although a lesser acid-combining power may be sometimes manifested. Thus, quinine can be either mono- or di-acid; ethylen-diamine and analogously-constituted bodies are di-acid (sometimes mono-acid also); the poly-ethylen triamines can be mono-, di-, or tri-acid, as can also rosanilin and its derivatives, or its homologues; the only poly-ethylen tetra-amines exhibit a maximum acid-combining power of four, and so on."

As quinine is referred, we give the following, from Lowig:—

The sulphate,	$C_{40}H_{25}O_4N_2O+SO_3$.
,, acid sulphate,	$HO,SO_3+C_{40}H_{25}O_4N_2O+SO_3$.
,, chloride,	$C_{40}H_{25}O_4N_2Cl$.
,, platinate,	$C_{40}H_{25}O_4N_2Cl+PtCl_2$.

The picture of sulphate of potash differs in no particular whatever! In both cases we have the sulphate, the acid sulphate (the di-, or double salt), and we may have the anhydrous di-salt of either quinine or potash.

This really is not a question of what *may be*, but of what the facts actually are as derived from modern authorities holding the same views with Dr. Wright.

It is in no way necessary to deny that rosanilin may be made to take up two or three atoms of acid, but I never saw it notated with more than one; and it is expressly stated to be "a monatomic triamine!"

I have excluded, *pro tem.*, di-pyridine and the morphia polymerides as possibly exceptional and fair subjects for enquiry; yet it is not a little curious that, as the morphia and di-morphia of Watts are both mono and normal, so, also, the same can be observed in the case of pyridine. The platina and platinosa pyridines of Reynolds have very complex notations, but they contain the following normal constituents:—

Platino-pyridine,	$C_{10}H_3H_2PtNCl+PtCl$.
Platoso-pyridine,	$(C_{10}H_3)_2H_4PtN_2Cl+PtCl$.

Schützenberger also obtains a very complex series, which may be simplified as follows, notating oxethyl as Ae:—

The amine,	Ae_3PtPCl.	
,, di-amine,	$Ae_6PtP_2Cl+PtCl$.	
,, tri-amine,	$Ae_3Pt_2H_3P_3Cl+PtCl$	$(-=PN_2)$.
,, tetra-amine,	$Ae_6Pt_2H_3P_4Cl+$	$(-=P_2N_2)$.

A recent research describes oxethyl, acetyl, allophanic acid—

The type,	$(CO)_4H_3N_2O+HO$.
,, acid,	$(CO)_4AeAcHN_2O+HO$.
,, potash salt,	$(CO)_4AeAcHN_2O+KO$.
Glyco-cyamine chloride,	$(C_4H_3O_4)CyH_5N_2Cl$.
,, chloro-platinate,	$(C_4H_3O_4)CyH_5N_2Cl+PtCl_2$.
Glyco-cyamidine ,,	$(C_4H_1O_2)CyH_5N_2Cl+PtCl_2$.

M. Claus obtains—

Glyci-diamine,	$(C_6H_5O_2)H_6N_2Cl+PtCl_2$.
The tri-amine,	$(C_6H_5O_2)H_9N_3Cl+PtCl_2$.

He also obtains some complex sulph-urea and melam derivatives—

The di-amine,	$Cy_3H_4N_2S+HS$.
,, tri-amine,	$Cy_6H_7N_3S+HS$.
,, hexamine,	$Cy_9H_9N_6S+HS$!

His notation for the tri-amine is peculiar, and wants one more H to satisfy my type. Either I am wrong, a printer's error has crept in, or that eminent physicist has not rightly estimated the analysis. It is given thus:—

$$CN_3(NH_2)_2NHCN_3(NH_2)_2S.$$

In a recent research, Mulder considers carbothialdine as "diethyliden-ammonium-sulpho-carbamate"—

$$NH_2-CS-S-N\begin{matrix}\diagup CH.CH_3.\\ \diagdown CH.CH_3.\end{matrix}$$

I have long ago notated it, in exact correspondence with that new description, as—

$$(CS)_2(C_4H_3)_2H_3N_2S+HS.$$

His di-allyliden analogue is—

$$(CS)_2(C_6H_3)_2H_3N_2S+HS.$$

There is also another—

$$(CS)_2(C_{10}H_9)_2H_3N_2S+HS.$$

Watts gives a sulph-urea nitrate—

$$(CS)_2H_5N_2O+NO_5.$$

Reynolds, an urea-tetra-amine—

$$(CS)_4H_7N_4Cl+PtCl_2.$$

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Cyan-benzylamide is $Cy_3(C_{14}H_7)_3H_3N_3$.
The tri-amine, $Cy_3(C_{14}H_7)_3H_4N_3Cl+PtCl_2$.
Also a similar body, $Cy_3(C_{14}H_5)_3H_4N_3Cl+PtCl_2$.

W. Pike has a recent research "On some Homologues of Oxaluric Acid." The substance of that paper is exceedingly good, but very much clouded by diatomic hypothesis and *bizarre* notation. He obtains analogues, rather than homologues, of oxaluric acid.

Oxalyl-urea, $CO_2\Theta\Theta_2H_2N_2$.
Oxaluric acid, $(CO)_2(\Theta\Theta)_2H_3N_2O+HO$ (1).
Succino-carbamic acid, $(CO)_2C_8H_3O_4H_4N_2O+HO$ (2).
Metal salts, $(CO)_2(C_8H_3O_4)H_4N_2O+KO$.
Citracon-sulpho-carbamic acid,— $(CS)_2(C_{10}H_3O_4)H_4N_2O+HO$ (3).
Metal salts, $CS_2C_{10}H_3O_4H_4N_2O+KO$.

1. $\begin{cases}CONH—CO—NH_2.\\CO.OH.\end{cases}$
2. $\begin{cases}CH_2—CO—NH—CO—NH_2.\\CH_2—CO.OH.\end{cases}$
3. $\begin{cases}C_3H_4 < \begin{matrix}CO—NH—CS—NH_2.\\CO.OH.\end{matrix}\end{cases}$

"The platinum salt of tri-ethyl-ammelide forms beautiful crystalline salts."

$$(CO)_2Cy_2E_2H_3N_3Cl+PtCl_2!$$

M. Cahours gives several phosphines and arsines, of which I only select two, E_3PtPCl and E_6PtAs_2Cl.

What is the difference between "di-cyan-diamide" and "di-cyan-diamine"?

Here, as in many other cases, I must urge that the notations of such men as Cahours, Berthollet, and others, better represent the facts than those current in England. In other words, the old notation better agrees with modern descriptions!

The amide, $Cy_2H_4N_2$ $=C\begin{matrix}NH\\NH\end{matrix}>C=NH_2$.

The amine, $Cy_2H_5N_2O+HO=C\begin{matrix}NH_2\\NH—CO—NH_2\end{matrix}$.

Cyanamide, CyH_2N.
Di-cyanamide, $Cy_2H_4N_2$.
Tri-cyanamide, $Cy_3H_6N_3$.
Mellen, $Cy_9H_3N_4$.
Melam, $Cy_6H_9N_5$.

Some of these are known in mono-saltic forms, and it is quite safe to infer the same character for all! The tri-amide is known as melamine nitrate, $Cy_3H_7N_3O+NO_5$; and a similar acetate and sulphate are given.

In a study of urea derivatives, we have seen that the tri-basic cyanurates are a misnomer and mistake; that they are in no sense ates, or true salts; and that, whenever they become amines, they evince mono characters, quite irrespective of the amount of condensation or of the number of N equivalents in the type. I hope, also, to have traced the true character and genesis of "uric acid." "If right in this, then my myko-melinic acid is the uric acid of the oxalyl series; and both ultimates, by an inverse reaction with 2HO, give corresponding pseudo-acid bodies:—

"Uric acid $+2HO=$
$=$pseudo-uric acid, $CO_2(C_6H_1O_6)CyH_5N_3$.
"Myko-melinic acid $+2HO=$
$=$the pseudo-acid, allantoin, $CO_2(C_4H_1O_4)CyH_5N_3$."

I call this the pseudo-acid simply out of deference to modern usage, but, in truth, neither are acids at all; they are amides, and may have metal substitutions, but such are not true salts.

Our meaning in this will be quite plain by a reference to the following "allantoin" derivatives, which I should notate as follows:—

Allantoin, $CO_2(C_4H_1O_4)CyH_5N_3$.
Potassium allantoin, $CO_2(C_4H_1O_4)CyH_4KN_3$.
Allantoic acid, $CO_2(C_4H_1O_4)CyH_6N_3O+HO$.
Allantoin nitrate, $CO_2(C_4H_1O_4)CyH_6N_3O+NO_5$.

The second is described as "the potash salt."

In that paper I had occasion to refer to pyruvic acid, and predict a similar series; while writing this, M. Grimaux has artificially produced the pyruvic pseudo-acid; it contains the elements of $CO_2(C_6H_3O_4)CyH_5N_3$.

I have alluded to the confusion and want of discrimination in regard to chloro-acetic acid; I here give two or three illustrations, first premising the general statement that glycolic acid, digested with ammonia, gives a mixture of three or more bodies:—

Glycollamide, $(C_4H_3O_4)H_2N$. (1).
Di-glycollamide, $(C_4H_3O_4)_2HN$. (2).
Tri-glycollamide, $(C_4H_3O_4)_3N$. (3).

Acetic acid similarly gives—

Acetamide, $(C_4H_3O_2)H_2N$.
Di-acetamide, $(C_4H_3O_2)_2HN$.
Tri-acetamide, $(C_4H_3O_2)_3N$.

Aldehyd similarly gives—

Ethenyl-amide, $(C_4H_3)H_2N$.
Di-ethenyl-amide, $(C_4H_3)_2HN$.
Tri-ethenyl-amide, $(C_4H_3)_3N$.

Yet, despite such facts as these, we are taught that ethenyl is a triatomic radical, and that it has the equivalence, or replaces 3H, &c.

Now, it is innocently said that chloracetic acid, with ammonia, gives three amidated acids; the first, called *amido-acetic acid*, or glycollamide (1), and that "amido-tri-glycollic acid" is tribasic.

The sad confusion, of which this is but a small specimen, in this direction is very pitiable.

The silver-salt, so-called, is—

$$(C_4\underline{H}_3O_4)_3N \quad (-=H_6Ag_3),$$

and similar salts are described with $K_2Ba_2E_3$, &c.

"Di-glycollamide nitrate of silver" reveals the true mono character of the salt when such exists—

$$(C_4H_3O_4)_2H_2NO+NO_5 \quad (-=H_5Ag).$$

The hydrate or acid—

$$(C_4H_3O_4)_2H_2NO+HO.$$

The silver and copper salts of di-ethyliden-lactamidic acid are similar amide substitutions.

Three remarks hereon:—

(1). An extended examination will show that all these bodies are simply monatomic, and that all the tri-bases so-called are mistaken amide derivatives.

(2). That the types and names are a complex product of confusion and misapprehension. Naquet's (2) is—

$$\left\{\left[\begin{matrix}C_2H_2O''\\H+\end{matrix}\right\}O\right]'\Bigg\}N = (C_4H_3O_4)_2HN.$$

(3). That the chloracetic acid is a mistaken isomeric glycollyl-chloride, one being $C_4\underline{H}_3O_2,O+HO$ $(-=H_2Cl)$, the other $(C_4H_3O_4)Cl$.

Hence the similar mistake of Dr. P. Romer, who says—"A mixture of *chloracetic acid* with strychnia to 180° C. for several hours gives a new base that he combined with platinic chloride," evidently the equivalent of—

Glycollic acid + strychnia − 2HO = new base.

$$(C_4H_3O_4)O+HO\ C_{42}H_{22}O_4N_2\ \left\{\begin{matrix}C_{42}H_{21}O_4\\C_4H_3O_4\end{matrix}\right\}=C_{46}H_{24}O_8N_2.$$

M. Huppert falls into the same error:—"The action of *chloracetic acid* upon morphine gives a new crystalline base"—

$$\left\{\begin{matrix}C_{34}H_{18}O_6\\C_4H_3O_4\end{matrix}\right\}=C_{38}H_{21}O_{10}N. \quad (a).$$

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Acetic acid + morphia − 2HO =

$$= \left.\begin{matrix} C_{34}H_{18}O_6 \\ C_4H_3O_2 \end{matrix}\right\} = C_{38}H_{21}O_8N. \quad (b).$$

Meth-alcohol + morphia − 2HO =

$$= \left.\begin{matrix} C_{34}H_{18}O_6 \\ C_2H_3 \end{matrix}\right\} = C_{36}H_{21}O_6N. \quad (c).$$

The first is called glycol-morphia. (*b*) is acetyl-morphia, and would be the same with chloracetic acid. (*c*) is methyl-morphia, or codeia.

Dr. Armstrong treats of the same subject (p. 265 of his esteemed manual), and the confusion is further confounded by printer's error. His ammonium salt of amido-acetic acid is, in all probability, no salt at all, and the hippuric acid in question is undoubtedly an amide—

Zinc Glycocoll. Chloride of Benzoyl.

$$(- = H_2ZN)\ \overbrace{C_4H_3O_4,H_2N} + (\overbrace{C_{14}H_5O_2)Cl} - ZnCl =$$

$$= \left.\begin{matrix} C_4H_2O_4 \\ C_{14}H_5O_2 \end{matrix}\right\} (C_{18}H_7O_6)H_2N.$$

The ammonia salt is probably—

$$\left.\begin{matrix} C_4H_3O_4H_2N \\ H_3N \end{matrix}\right\} \quad \text{or} \quad (C_4H_3O_4)H_5N_2.$$

And the proof is plainly involved in the context, "the which amido-acetic acid is found to be in all respects identical with glycocoll from hippuric acid."

Again, "the action of *chloracetic acid* on methylamine gives methyl-amido-acetic acid, which is identical with sarkosine, a product derived from creatine;" and here, again, we have a saltic notation for that which is undoubtedly an amide.

Substitute, for the *chloracetic acid*, glycollyl-chloride, and the context is plain to the meanest capacity, as the action of that body on methylamine would naturally give the type—

$$(C_2H_3)H_2N + C_4H_3O_4,Cl - HCl =$$

$$= \left.\begin{matrix} C_4H_2O_4 \\ C_2H_3 \end{matrix}\right\} = (C_6H_5O_4)H_2N.$$

Creatin may be produced by the direct union of sarkosine and cyanamide—

$$\left.\begin{matrix} C_6H_5O_4,H_2N \\ CyH_2N \end{matrix}\right\} = (C_6H_5O_4)CyH_4N_2.$$

In dealing with single cases it is easy to be misled; and if Dr. Armstrong contended that the amido-acetic acid was $(C_4H_1O_2)H_3NO + HO$, and the ammonic salt $(C_4H_1O_2)H_3NO + AO$, or the equivalents of such types in diatomic notation, it might be difficult to demur; but even then the difficulties and contradictions would be great. But if we estimate the subject in the light of his triplet, and study the matter in its extended ramifications, the simple truth becomes irresistible.

$N\left\{\begin{matrix} CH_2CO(OH) \\ H \\ H \end{matrix}\right.$	$N\left\{\begin{matrix} CH_2CO(OH) \\ CH_2CO(OH) \\ H \end{matrix}\right.$	$N\left\{\begin{matrix} CH_2CO(OH) \\ CH_2CO(OH) \\ CH_2CO(OH) \end{matrix}\right.$
Glycollamidic Acid. Amido-acetic Acid (1).	Di-glycollamidic Acid (2).	Tri-glycollamidic Acid (3).

Notations indicating a mono-, di-, and tri-basic compound, where none such exists.

The ethylen or ethyliden bodies form no exception to the general rule—

Ethenyl-diphenyl-diamine,	$C_{28}H_{14}N_2$.
The chloride,	$C_{28}H_{14}N_2HCl$.
,, chloro-platinate,	$C_{28}H_{14}N_2HCl + PtCl_2$.
,, nitrate,	$C_{28}H_{14}N_2HO + NO_5$.

One is tempted to give these in rational formulæ, but, as the cyano tendencies are specially great, and the higher nitrile radicals are a kind of forbidden ground, it may be better to treat the ammonia constituents as one group.

Diazo-benzene nitrate has one atom of NO_5, the hydrate one HO, and the potash salt one KO.

Diazo-benzamide has the elements of $C_{14}H_5O_2N_3$, the nitrate $C_{14}H_5O_2N_3 + NO_5$.

Amido-benzene is expressly said to be "a monacid base."

The chloride,	$C_{24}H_{12}N_3Cl$.
,, chloro-platinate,	$C_{24}H_{12}N_3Cl + PtCl_2$.
,, nitrate,	$C_{24}H_{12}N_3O + NO_5$.
Amido-oxybenzene,	$C_{24}H_{11}O_2N_3$.
The chloride,	$C_{24}H_{11}O_2N_3HCl$.
,, chloro-platinate,	$C_{24}H_{11}O_2N_3HCl + PtCl$.

M. Demole has a recent research "On Hydrox-ethylen amines." Of these he gives five varied series, and by their oxalates, sulphates, chloro-platinates, &c., they are all strictly monacid.

Of the N_4, caffeine, M. Schorlemmer says—"It is a monacid base."

Such cases might be multiplied *ad infinitum*, and, as no special selection has been made, I give the only contrary case from my rough notes; it is that of acridine, which is perfectly parallel with the case of dipyridine. It is either $C_{12}H_9N$ or $C_{24}H_{18}N_2$; and in the latter case, all the acids in a long list are di.

That chemists should assume so much, where the simple truth of nature could be easily and finally tested, is to me a regrettable amazement.

I have long thought that, as O = 8, S and Pt, like Cl, replace H, atom for atom, so there should be no reason why C = 6 and Si should not also form one of the ammonia constituents. I have collated several cases in this direction, and a recent memoir on "Guanimine" is specially appropriate.

Guanamine,	$C_8H_7N_5$.
The chloride,	$C_8H_8N_5Cl$.
,, nitrate,	$C_8H_8N_5O + NO_5$.
,, sulphate,	$C_8H_8N_5O + SO_3$.
,, acetate,	$C_8H_8N_5O + AcO$.

In conclusion, I would call attention to a very notable fact, viz., that guanamine as a poly-amine has 16 H equivalents, and not 20; and all the others are similarly proportionate. It is so by a law of genesis, as fertile and predominant with amines as it is with hydrocarbon hydrates; yet the contrary is assumed in all the manuals, and Dr. Armstrong is silent on the subject.

That truth is paramount now as when uttered by the stifled voice of Galileo is, however, seen in the tardy admission involved in Dr. Hofmann's elegant demonstration before the Chemical Society, that, when Cl replaces O, it does so by the absorption of one volume for the elimination of half a volume.

NOTES ON THE ANALYSIS OF MINIUM OR RED LEAD.

By THOMAS P. BLUNT, M.A. Oxon, F.C.S.

THE analysis of red lead presents peculiar difficulties, principally due to the minute proportion of impurities to be found in good samples. The following process includes the more important of these, viz., (1) iron, (2) copper, (3) metallic lead, and to these is added a new method of estimating the silver, which might probably be applied with advantage to the analysis of galena and metallic lead with a view to cupellation. The process given for the colorimetric estimation of copper, which is very delicate and precise, is also new so far as the writer is aware.

(1). *Iron.*—100 grains of minium is dusted gradually with half an ounce of pure re-distilled hydrochloric acid contained in a beaker; torrents of chlorine are given off, and the consequent agitation of the liquid prevents caking, which invariably occurs when the acid is poured over the weighed sample, and is very troublesome, as it prevents the interior of the lumps from being properly acted upon by the acid. The beaker and its contents are now transferred to the water-bath, and evaporation is carried almost to dryness; the residue is then diluted with

some quantity of water, and the whole allowed to cool; the clear liquid is now decanted off as closely as possible from the chloride of lead which has precipitated, and the latter is washed with a small quantity of cold water, the rinsings being added to the bulk of the liquid, which need not be absolutely clear. Sulphuric acid is then added, and the precipitation, decantation, and slight washing, repeated.

The liquid, which is now almost free from lead (though still retaining traces, apparently in the form of a per-salt not entirely decomposable by sulphuric acid) is in a fit state for the determination of iron and copper. Ammonia in considerable excess is added, and the precipitate is collected on a filter and washed. It is yellowish-white in colour, and contains all the iron and some lead. After thorough washing the filter is pierced, the precipitate washed into a small flask as completely as possible, and the filter rinsed several times with dilute sulphuric acid, which is allowed to run into the flask; the whole is then warmed, upon which the oxide of iron is dissolved, and the traces of lead-salts converted into sulphate, which does not interfere with the succeeding operation, though it is reduced to the metallic state. The liquid is now heated for some time with a few fragments of perfectly pure zinc, filtered, and titrated with very weak permanganate solution, which may be conveniently delivered from a pipette divided into grains. The permanganate solution should be of such strength that at least 1000 grain-measures are required to peroxidise 1 grain of metallic iron.

(2). *Copper.*—The ammoniacal filtrate from the iron oxide is neutralised with acetic acid and divided into two equal portions; to one of them is added a small measured quantity (about 3 grains) of ordinary ferrocyanide of potassium solution; a red colour will be produced more or less deep according to the quantity of copper present; the liquid is filtered *immediately** through close paper, and if the red colour is not entirely removed it is passed a second time through the same filter. The clear and very faintly yellow solution is then transferred to one of two twin beakers, the other containing the second portion of solution from which the copper has not been removed. A measured quantity (about 20 grains) of acetic acid is now added to each, and three grain measures of ferrocyanide solution to that which has not yet received any; the beakers are placed on a white surface, and the colour produced by the copper in the second beaker is matched in the first by the gradual addition, with stirring, of a standard solution of copper sulphate from a graduated pipette, about a minute being allowed between each addition for the full development of the tint. The copper solution is made by dissolving 39·3 grains of pure crystalised copper sulphate (free from efflorescence) in 10·000 grains of distilled water, which gives 1 part of metallic copper in 1000 measured grains. The number of grain measures required multiplied by 2 and transferred to the third decimal place, gives the percentage of metallic copper; thus,—to take an actual case,—3½ grain measures of the solution were required to match the tint given by the copper in a minium treated as above; therefore the sample contained 0·007 per cent of copper.

It is absolutely necessary to use a comparison liquid prepared in the manner described, and corresponding exactly to the solution to be tested, except that it contains no copper, since it has been proved by careful experiment that the quantity of ammoniacal salts present has a material effect upon the tint produced.

(3). *Metallic Lead.*—This impurity is generally found in the form of minute beads distributed throughout the sample; it is best detected and estimated by dissolving the lead oxides in glacial acetic acid in the following manner:—1 oz. of acetic acid of the kind commercially described as "glacial at 32°" is placed in a beaker, and 20 grains of the minium—which must of course be in fine powder—is dusted into it; the beaker is placed in warm water (about 100° F.) and the contents frequently stirred; in the course of from a quarter to half an hour the whole of the lead oxides present will be dissolved, metallic lead remaining behind, together with any foreign matter such as bole, which may have been added as an adulterant. The solution may be decanted off, and the residue washed first with glacial acid and then with water, dried, and weighed.

It has been found that minute fragments of bright metallic lead are not appreciably acted upon by the acetic solution of minium, in spite of its well known powerfully oxidising properties, but are merely superficially tarnished without entirely losing their lustre.

(4). *Silver.*—200 grains of minium are treated with a mixture of ½ oz. of nitric acid, sp. gr. 1·42, entirely free from chlorine, and 1½ ozs. distilled water also free from chlorine, and giving no turbidity with silver nitrate; the mixture becomes hot. It is stirred at intervals during two hours, and is then diluted with pure distilled water to about 4 ozs., and filtered, the residue being washed once with a small quantity of distilled water. The filtrate, which should measure from 4½ to 5 ozs., is then divided into two equal parts. The rest of the process is similar in principle to that employed for copper, but here turbidity, not colour, forms the basis of comparison. The two halves of the liquid having been placed in two similar beakers, one is set aside and covered with a watch-glass, to the other is added one drop of strong hydrochloric acid; a precipitate will appear which re-dissolves on stirring, leaving only a faint turbidity due to the silver. Allow to stand for a short time and filter, washing once with a few drops of distilled water; return the filtrate and washings to the beaker, and place the latter beside that which has been set aside. Both beakers should be placed *in front* of a black surface of cloth or dull silk, to facilitate the estimation of the turbidity. Add now one drop of strong hydrochloric acid to the beaker from which the silver has not been removed, stir, and note the turbidity produced, which is to be matched in the other beaker by stirring in measured quantities—about one grain at a time—of a dilute solution of nitrate of silver, prepared by dissolving 15·7 grains of the crystals in 10·000 grains of pure distilled water. The solution contains 0·001 grain metallic silver in every measured grain, and consequently the number of grain measures added to produce the required turbidity give the percentage of silver at the third decimal place. An interval of about half a minute should be allowed between each addition, and both solutions should be frequently stirred during the operation. The use of the "comparison liquid" is rendered necessary by the fact that the dissolved lead salts diminish the apparent turbidity produced by the chloride of silver. The phenomenon is not easy of explanation, as it is independent of any solvent action, and takes place equally in a solution which has been saturated with silver chloride by a previous precipitation.

* If the filtration is delayed a yellow colour is produced which interferes materially with the subsequent operation; it appears to be due to the oxidation of the ferro- to ferrol-cyanide.

Researches on Magnetic Rotatory Polarisation.—M. H. Becquerel.—Since Faraday's discovery the phenomenon of magnetic rotatory polarisation has been the subject of numerous researches. It has been remarked that bodies strongly refractive have generally also a great magnetic rotatory power; but the exceptions to this rule have hitherto prevented any connection between these two physical attributes from being established. The author finds in his experiments that many bodies present a regular increase of rotation as the index of refraction augments. The exceptions observed may be attributed either to the effects of lamellar polarisation, as in the diamond and garnet; or to the presence of magnetic bodies; or, lastly, to unknown causes.—*Comptes Rendus*, vol. lxxx., No. 22.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from page 274).

If we consider oxygen from these three points of view, its metallurgical applications first draw our attention. What it has already done for the platinum manufacture has been explained above. For the autogenous soldering of lead it has been dispensed with, since hydrogen or coal-gas burnt in atmospheric air gives out a sufficient heat; but the example of this art encourages us in connecting great hopes with the extended applications of oxygen. Says an esteemed practical metallurgist, Clemens Winkler:†—"As gold, when used for soldering platinum vessels, impairs the appearance, since the soldered places appear yellow, in the same manner the whiteness of soft solder is an eyesore when it is applied to coloured metals. This evil induced the Prussian Association for the Promotion of Manufacturing Industry to offer a reward for the discovery of a yellow solder—a problem not easy to solve without the prior discovery of a new easily fusible metal of a red or yellow colour.‡ It would be more useful to turn our attention to the autogenous soldering of metals with the aid of the oxyhydrogen flame, a principle which has achieved such signal triumphs in the treatment of two essentially different metals. Should it not be possible, by the same means, to solder every metal and every alloy with itself, as tin with tin, copper with copper, brass with brass, silver with silver, gold with gold, and even iron with iron, just as we already solder lead with lead and platinum with platinum? The probability is present, and the advantages of such a procedure are manifest. Let us try to conceive the neatness of a workshop in which soldering is performed, not as heretofore, with the soldering-iron or at the forge, but with a light, elegant gas-burner. Imagine the artisan no longer annoyed by radiant heat and by the fumes of charcoal, and able to produce in a moment any temperature required, even the very highest, and again to put an end to it by simply turning a cock. Conceive the solidity of the soldering which no longer depends on cementing two pieces of metal with a foreign matter, but on an actual interfusion of two portions of one and the same metal, and which involves the utmost economy of materials and dispenses with all subsequent work, such as trimming the soldered place with a file. Such evident advantages must overcome every prejudice, and prompt us most urgently to commence a thorough experimental investigation of the question."

But also in the most extensive fields of metallurgy, the preparation of iron and steel, technologists of merit have pointed out the advantages to be derived from cheap oxygen.

Cameron‖ recommends the use of oxygen or of air rich in oxygen, as obtained from Mallet's absorption-cylinders instead of ordinary air in blast-furnaces; and we may here remark that the absorption of oxygen in water has been already unintentionally used for this purpose, although in a form capable of improvement. Br. Kerl§ has called attention to the fact that the air from the water-blast is richer in oxygen than common air.

(To be continued.)

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† Clemens Winkler, *Deutsche Industrie Blatter*, p. 182. *Zeitschrift d. Vereins Deutsch. Ingen.*, xvi., 714.

‡ The offer has, therefore, been subsequently withdrawn.

‖ Cameron, *Berg. u. Hüttenm. Zeitung*, 1871, 132.

§ Br. Kerl, *Grundriss der Hüttenkunde*, i., 217.

ON THE ESTIMATION OF PHOSPHORIC ACID AS AMMONIO-MAGNESIAN PHOSPHATE.

By THOMAS ROBERTSON OGILVIE.

(Continued from vol. xxxi., p. 275.)

C.—*Precipitation of P_2O_5 in Presence of Varying Quantities of Ammonium Sulphate and an Excess of Magnesia-Mixture.*

No. of Expt.	NH_4O,SO_3.	Mg. Mix. = 7 c.c.
1	0·25 grm.	0·3160 grm.
2	0·50 ,,	0·3160 ,,

In the analysis of a superphosphate there cannot be more than a limited quantity of sulphuric acid present. This acid, originally in the manure as calcic sulphate and free acid—and possibly also as ammonium sulphate—remains in the portion employed for analysis after the removal of the lime as ammonium sulphate. There can never be more than 50 per cent of this salt associated with the phosporic acid in its precipitation, as hydrochloric acid, and not sulphuric acid, is used as the solvent for the portion of the manure insoluble in water; and so it is altogether irrelevant to consider the interfering effect of a greater quantity of this salt. It is different with ammonium chloride, as it may be present in greater or less quantity according as hydrochloric acid is used sparingly or otherwise.

These experiments, along with the ones in (A *b*) show that the addition of much sulphuric acid, combined with magnesia, and without a relative increase in ammonium chloride, leads to high results; and that the addition of a moderate quantity of sulphuric acid, associated with ammonia, and in presence of not more than 50 per cent of an excess of "magnesia-mixture," does not do so.

D.—*Precipitation of P_2O_5 in Presence of Varying Quantities of Ammonium Oxalate and of Magnesia-Mixture.*

No.	$NH_4O,\bar{O}$.	Mg. Mix. 7 c.c.	Mg. Mix. 13·5 c.c.	Mg. Mix. 20 c.c.
	grm.	grm.	grm.	grm.
1	0·25	0·3130	0·3260	0·3295
2	0·50	0·3120	0·3295	0·3300
3	1·00	0·3120	0·3285	0·3270
4	1·50	0·3090	0·3255	0·3310
5	2·00	0·3075	0·3255	0·3320
6	2·50	0·3065	0·3255	0·3285

E.—*Precipitation of P_2O_5 in Presence of Varying Quantities of Citric Acid and Magnesia-Mixture.*

No.	Citric Acid.	Mg. Mix. 7 c.c.	Mg. Mix. 13·5 c.c.	Mg. Mix. 20 c.c.
	grm.	grm.	grm.	grm.
1	0·25	0·3105	0·3215	0·3250
2	0·50	0·3100	0·3240	0·3270
3	1·00	0·3100	0·3240	0·3265
4	1·50	0·3070	0·3220	0·3230
5	2·00	0·3055	0·3200	0·3220
6	2·50	0·3040	0·3175	0·3230

F.—*Precipitation of P_2O_5 in Presence of a Fixed Quantity of Citric Acid, Varying Quantities of Ammonium Oxalate, and Varying Quantities of Magnesia-Mixture.*

No.	Citric Acid.	$NH_4O,\bar{O}$.	Mg. Mix. 7 c.c.	Mg. Mix. 13.5 c.c.	Mg. Mix. 20 c.c.
		grm.	grm.	grm.	grm.
1	0·50	0·25	0·3115	0·3265	0·3310
2	0·50	0·50	0·3115	0·3275	0·3345
3	0·50	1·00	0·3105	0·3260	0·3370
4	0·50	1·50	0·3080	0·3235	0·3355
5	0·50	2·00	0·3070	0·3235	0·3340
6	0·50	2·50	0·3050	0·3230	0·3330

G.—*Precipitation of P_2O_5 in Presence of a Fixed Quantity of Ammonium Oxalate, Varying Quantities of Citric Acid, and Varying Quantities of Magnesia-Mixture.*

No.	Citric Acid.	$NH_4O,\bar{O}$.	Mg. Mix. 7 c.c.	Mg. Mix. 13·5 c.c.	Mg. Mix. 20 c.c.
		grm.	grm.	grm.	grm.
1	0·25	0·50	0·3120	0·3310	0·3355
2	0·50	0·50	0·3110	0·3270	0·3340
3	1·00	0·50	0·3070	0·3265	0·3340
4	1·50	0·50	0·3045	0·3250	0·3345
5	2·00	0·50	0·3035	0·3210	0·3285
6	2·50	0·50	0·3020	0·3160	0·3250

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These four series of experiments (D to G) set forth very plainly the action of ammonium oxalate and citrate. Two features of this action must be noted:—First, that in presence of a moderate excess of "magnesia-mixture" both salts render the precipitate of ammonio-magnesian phosphate to a greater or less extent soluble according to the quantity of each present, and in that way cause the results to be low; and, second, that in presence of a larger excess of "magnesia-mixture" this solvent action is counterbalanced by the precipitation of magnesium oxalate and citrate, along with the ammonio-magnesian phosphate, and so high results are got. These experiments, I think, indicate why one authority asserts that ammonium citrate gives a precipitate, and another that it does not, with "magnesia-mixture." Hitherto, little attention has been given to the action of ammonium oxalate, but these tables show that its presence is nearly as objectionable as that of ammonium citrate; and I am afraid that some analysts, under the impression that lime will not come down by boiling within a short time unless a large excess of ammonium oxalate is present, often vitiate their estimations by its excessive use. Even, however, by using the least possible quantities of these salts an erroneous result will be got, which will be either low or high according as a moderate or a large excess of magnesia is employed. It is worthy of remark, also, that in the experiments in which the largest proportion of "magnesia-mixture" was used, the precipitates were not only the highest, but the most irregular in weight and colour.

H.—*Precipitation of* P_2O_5 *in Presence of a Fixed Quantity of Ammonium Oxalate, Citric Acid, Oxide of Iron, Alumina, and Varying Quantities of Magnesia-Mixture.*

No.	$NH_4O,\bar{O}$.	Citric Acid.	Fe_2O_3.	Al_2O_3.	Mg. Mix.	$2MgO,P_2O_5$.
	grm.	grm.	grm.	grm.	c.c.	grm.
1	0·5	0·5	0·035	0·013	7	0·3225
2	0·5	0·5	0·035	0·013	13·5	0·3280
3	0·5	0·5	0·035	0·013	20	0·3440

I.—*Same as* (H), *but with Double the Quantity of Citric Acid.*

No.	$NH_4O,\bar{O}$.	Citric Acid.	Fe_2O_3.	Al_2O_3.	Mg. Mix.	$2MgO,P_2O_5$.
	grm.	grm.	grm.	grm.	c.c.	grm.
1	0·5	1	0·035	0·013	7	0·3195
2	0·5	1	0·035	0·013	13·5	0·3190
3	0·5	1	0·035	0·013	20	0·3200

K.—*Precipitation of* P_2O_5 *in Presence of a Fixed Quantity of Ammonium Oxalate, Citric Acid, Oxide of Iron, Alumina, and Varying Quantities of Magnesia-Mixture.*

No.	$NH_4O,\bar{O}$.	Citric Ac.d.	Fe_2O_3.	Al_2O_3.	Mg. Mix.	$2MgO,P_2O_5$.
	grm.	grm.	grm.	grm.	c c.	grm.
1	0·5	1	0·07	0·026	7	0·3170
2	0·5	1	0·07	0·026	13·5	0·3280
3	0·5	1	0·07	0·026	20	0·3565

L.—*Same as* (K), *but with Double the Quantity of Citric Acid.*

No.	$NH_4O,\bar{O}$.	Citric Acid.	Fe_2O_3.	Al_2O_3.	Mg. Mix.	$2MgO,P_2O_5$.
	grm.	grms.	grm.	grm.	c.c.	grm.
1	0·5	2	0·07	0·026	7	0·3115
2	0·5	2	0·07	0·026	13·5	0·3085
3	0·5	2	0·07	0·026	20	0·3095

M.—*Precipitation of* P_2O_5 *in Presence of a Fixed Quantity of Ammonium Oxalate, Citric Acid, Oxide of Iron, Alumina, and Varying Proportions of Magnesia-Mixture.*

No.	$NH_4O,\bar{O}$.	Citric Acid.	Fe_2O_3.	Al_2O_3.	Mg. Mix.	$2MgO,P_2O_5$.
	grm.	grms.	grm.	grm.	c.c.	grm.
1	0·5	4	0·07	0·26	7	0·2810
2	0·5	4	0·07	0·26	13·5	0·2700
3	0·5	4	0·07	0·26	20	0·2665

(To be continued).

SOCIETY OF PUBLIC ANALYSTS.

The following paper was read at the meeting on June 2nd:—

ON THE VOLUMETRIC ESTIMATION OF CHLORIDES AND THE PRESENCE OF ALKALINE PHOSPHATES.

By W. C. YOUNG, F.C.S.

In endeavouring to estimate the chlorine volumetrically in a sample of vinegar suspected to contain free hydrochloric acid, I found it almost impossible to decide when the change of colour first took place; instead of the usual deep red precipitate, a light brown precipitate appeared, and the colour did not change until so much of the standard solution had been used as convinced me something was wrong. At first, I attributed the cause to the alkaline carbonates present, of which, as the vinegar had been neutralised by soda before evaporation and incineration, there was a considerable quantity. After carefully neutralising a fresh portion of ash by acetic acid, the same difficulty occurred in the volumetric estimation of the chlorine.

On investigation, the cause of the difficulty proved to be the alkaline phosphates present; and, after precipitation by sulphate of calcium, the total chlorine in this vinegar amounted to 1·75 grains per 1000, whereas before it amounted to 2·8 grains per 1000, this being calculated from the number of grain measures of standard solution of nitrate of silver required to produce the first perceptible alteration in the colour of the precipitate. Thus, a difference of 1·05 grains of chlorine was occasioned by the alkaline phosphates in the ash.

In order to see how much the volumetric estimation of chlorine was affected by the presence in solution of carbonate of sodium, phosphate of sodium, or pyrophosphate of sodium, I made the following experiments. 0·7 grain of chloride of sodium was taken in each case, and a few drops were added of a strong solution of one of the salts supposed to affect its estimation volumetrically. A considerable excess of chromate of potassium was used.

	Cold.	At about 120° F.
	Gr. Cl.	Gr. Cl.
0·7 grain NaCl with Na_2CO_3 indicated	0·425	0·435
" " " Na_2HPO_4 "	0·430	0·465
" " " $Na_4P_2O_7$ "	0·575	0·750

By these results, it will be seen that the presence of carbonate of sodium did not affect the estimation in the cold, and only slightly when hot; phosphate of sodium in the cold only affects the estimation slightly, but rather more when hot; while pyrophosphate of sodium interferes to so great an extent, that it is obvious that volumetric estimations of chlorine in its presence are worthless.

In the first experiment the change of colour was easily observed, the depth increasing at each addition of the standard solution; whilst in the second the change of colour was so gradual that it was difficult to decide when it first occurred—moreover, the colour pervaded the whole precipitate, instead of, as is usual, the liquid above the precipitate. The third experiment presented the same appearance as the second.

I tried the effect in hot solutions as well as cold, because the standard solution is frequently applied immediately after the solution of an ash in hot water.

Having observed this effect of the alkaline phosphates, I proceeded to find how far the estimation of chlorides in ashes is affected by the phosphates contained therein.

Vinegar Ash.—The normal ash of the sample used indicated 0·14 Cl per 1000; after precipitation by sulphate of calcium, it indicated 0·13 Cl per 1000. After adding a few drops of hydrochloric acid to this vinegar and carefully neutralising by potash, the solution of the ash behaved in precisely the same manner with the standard solution of nitrate of silver as did the vinegar already referred to as

directing my attention to this subject, and it was impossible to say when the precipitation of the chloride of silver had ceased. 3·5 grains of Cl had been indicated long before a decided red tint was observable.

There is no doubt that, in this experiment, a large amount of the insoluble phosphate had been converted into alkaline phosphate by the carbonate of potash formed by the ignition of the potash salts present.

After separation of phosphates, 1000 = 0·55 Cl.

Milk Ash.—The amount of alkaline phosphate present in normal milk ash is so small that its effect upon the estimation of the chlorides is inappreciable; but with milk to which carbonate of sodium has been added, the alkaline phosphates in the ash are increased and the effect is more marked. The lowest and highest differences I have observed are these:—

	Before Precipitation of Phosphates. Gr.	After Precipitation of Phosphates. Gr.
Cl in ash from 100 grain measures =	0·082	0·078
" " " =	0·090	0·084

Beer Ash.—

	Before Precipitation of Phosphates.	After Precipitation of Phosphates.
1. Cl per 1000	0·320	0·301
2. " "	0·371	0·360

When an alkaline carbonate has been added to beer to correct acidity, the alkaline phosphates in the ash are increased, and the difference before and after their separation is very decided, as will be seen from the following experiment:—

	Before Precipitation of Phosphates.	After Precipitation of Phosphates.
Cl per 1000	0·5	0·32

Cocoa Ash.—In applying the volumetric solution of nitrate of silver to the ash of cocoa, at first no precipitate is formed, then for some time a white precipitate, afterwards a light brown precipitate, and finally chromate of silver. It was almost impossible to decide when the first alteration of colour occurred. The ash from 50 grains of this cocoa indicated, after precipitation of the alkaline phosphates, 0·01 grain Cl.

In short, the appearances presented in this experiment were precisely the same as if pyrophosphate of sodium had been used instead of the ash of cocoa.

Thus, the volumetric estimation of chlorine in the ash of vinegar, beer, milk, or cocoa is affected more or less by the alkaline phosphates present.

A BATCH of milk adulteration cases recently disposed of at the Greenwich Police Court gave occasion for the display of a phase of the magisterial mind which is, perhaps, unique.

The cases were five in number. The largest quantity of added water certified to was 33 per cent, and, as the defendant in this case was fined 40s., no special remark is called for.

Of the other four milk dealers, one had added 10 per cent of water, one 15 per cent, and the remaining two each 18 per cent. The first case the magistrate at once dismissed, asserting his opinion that the discovery of such a small quantity of added water was an analytical impospossibility. The solids not fat in this case were only 7·92. The other three cases were adjourned for a week, to enable the magistrate to make up his mind. At the adjourned hearing the Analyst was in attendance to verify his results, but the magistrate declined to let him be examined, and, notwithstanding that there was no defence and no counter testimony, he simply ordered the defendants to pay the cost of the summonses, some two shillings each. The amount of solids not fat in these three cases was, respectively, 7·11, 7·42, 7·32.

NOTICES OF BOOKS.

Chemical and Geological Essays. By THOMAS STERRY HUNT, LL.D. Boston: J. R. Osgood and Co. London: Trübner and Co.

IN Europe, as in America, Dr. T. S. Hunt is widely and honourably known as an acute and indefatigable investigator of nature. In chemistry, mineralogy, and geology, and especially in the bearings of the former science upon the latter, he has done work of standard merit and of abiding interest. The volume before us comprises essays on the theory of igneous rocks and volcanoes; on certain points in chemical geology, including a comparison of ancient and modern sea-waters, and considerations on the geological distribution of volcanoes; on the chemistry of the metamorphotic rocks; on the chemistry of the primæval earth, in which the author accounts for the climatic heat of certain geological epochs by showing that the relatively large amount of carbonic acid in the atmosphere must, as demonstrated by Tyndall, arrest the loss of heat by nightly radiation; on the origin of mountains; on the probable seat of volcanic action; on some points in dynamical geology, in which he adopts the physical theory of earthquakes propounded by G. L. Vose; on limestones, dolomites, and gypsums; on the chemistry of natural waters, with an appendix on the porosity of rocks; on petroleum, asphalte, pyroschists, and coal, in which he combats the view that petroleum has been formed by the destructive distillation of the pyroschists (*brand schiefer*); on granites and granitic vein-stones; on the origin of metalliferous deposits, with an appendix on the presence of iodine and gold in sea-water, as established by Sonstadt (CHEMICAL NEWS, 1872, April 26, May 17, and May 24); on the geognosy of the Apalachians, and the origin of crystalline rocks; on the geology of the Alps; on the history of the names Cambrian and Silurian in geology; on the theory of chemical changes and on equivalent volumes; on the constitution and equivalent volume of mineral species; thoughts on solution and the chemical process, where the author contends that all solution is chemical union; on the objects and method of mineralogy, and on the theory of types in chemistry.

These essays are not, indeed, new to the scientific world. Some of them have been read before distinguished learned societies, and all have appeared in print in the *Chemical Gazette*, *American Journal of Science*, *Dublin Quarterly Journal*, *Canadian Journal*, *&c.*, and one, at least, has been the subject of discussion in our own columns. Still their re-publication in a compact form will prove a great convenience to the student, who might otherwise be compelled to seek them, for reference, through a great bulk of periodical literature.

In examining the work we were much struck with the following passage, appended as a footnote to the paper on the "Theory of Types:"—"Those who are familiar with chemical literature will remember an amusing *jeu d'esprit* of Laurent's, in which he invited the attention of the advocates of the radicle theory to a newly-invented electro-negative radicle, eurhizene (*Comptes Rendus des Travaux de Chimie* for 1850, pp. 251 and 376). A late writer in the CHEMICAL NEWS (vol. i., p. 326) proposes as a new electro-negative radicle, under the name of hydrine, the peroxide of hydrogen, HO_2, the eurhizene of Laurent." Were Laurent still living, he would be ostracised if he dared to "speak disrespectfully" of eurhizene, under its new *alias* of hydroxyl!

The following passage may not be unworthy of attention:—"I am convinced that no geometrical grouping of atoms, such as are imagined by Macvicar and by Gaudin, can ever give us an insight into the way in which Nature builds up her units."

CORRESPONDENCE.

FILTERING CONES.

To the Editor of the Chemical News.

SIR,—Most chemists in the habit of using Bunsen's filtering apparatus must have experienced some inconvenience in the use of the platinum cones. At the recommendation of a friend, I was induced to try the following simple substitute for them, and found it to answer so well, that I would call the attention of your readers to it, in case it is not generally known. Place inside of the glass funnel used a small filter of parchment-paper pierced at the bottom with a fine needle; afterwards place the ordinary filter in the funnel, and filter as usual. Such cones of parchment-paper can be used in any required size, are easily obtained, and may be applied to almost all purposes where the more expensive platinum cones have hitherto been used.—I am, &c.,

M. H. COCHRANE.

Tübingen, June 20, 1875.

BLOOD ALBUMEN.

To the Editor of the Chemical News.

SIR,—Seeing in CHEMICAL NEWS, vol. xxxi., p. 269, a short note referring to E. Kopp's process for the decolorisation of blood albumen by means of *ozonised air*, I am reminded of a process of my own which is somewhat similar in its nature, and for the same purpose, but which fell through as a commercial undertaking on the score of *expense*; but, nevertheless, I doubt not will be considered interesting.

My process consists in simply dissolving the dark coloured blood albumen of commerce in water at about 100° F., and then (after separation from the insoluble portion which always exists in this quality of albumen) adding, whilst hot, a small quantity of *binoxide of hydrogen*. The nascent oxygen, or ozone, which is thus liberated acts *immediately* upon the colouring matter of the serum, and, upon evaporation of the latter to dryness upon a flat glass plate or bath, the albumen readily peels off, and is obtained of a light straw colour and completely soluble in water.—I am, &c.,

GEORGE JONES, F.C.S.

106, Leadenhall Street, E.C.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 22, June 7, 1875.

Transformation of Camphor into Camphene and, Reciprocally, of Camphenes into Camphor.—M. J. Ribau.—The conversion of camphor into camphene gives considerable support to the opinion which regards the camphenes as the generators of camphor.

Thiammeline, a New Derivative of Persulpho-Cyanogen.—M. J. Ponomareff.—The new compound, $C_3N_5H_5S$, represents ammeline, in which oxygen is replaced by sulphur. It is produced at the expense of persulpho-cyanogen by the replacement of two atoms of sulphur by two residues, NH_2. Thiammeline dissolves readily in mineral acids and in alkalies, but it does not yield definite salts, either with acids, or with alkaline and alkaline-earthy bases. With the salts of the heavy metals it yields amorphous insoluble precipitates.

Dissociation of Sulpho-Carbonate of Potassium in Presence of Ammoniacal Salts.—M. Rommier.—Under the influence of ammoniacal salts sulpho-carbonate of potassium loses a part of the sulphide of carbon which enters into its composition.

Fluoren, and its Derivative Alcohol.—M. P. Barbier.—The author describes fluorenic alcohol, $C_{26}H_8(H_2O_2)$, obtained by causing sodium amalgam to react upon diphenylen carbonyl in alcoholic solution; fluorenic ether, $C_{26}H_8(C_{26}H_{10}O_2)$; and fluorenacetic ether, $C_{26}H_8(C_4H_4O_4)$.

Researches on Taurin.—M. R. Engel.—Taurin is not in reality an amide, but a true glycocoll, that is to say, an acid amine.

Bibromide of Angelic Acid.—M. E. Demarçay.—The author consider this body completely identical with methyl-crotonic acid.

Analysis of the Coal of the Island of Suderoe.—MM. Beghin and C. Mène.—Suderoe, one of the Faroe group, contains important beds of coal in dolerite rocks. It yields—

Volatile matter	46·520
Coke	51·980
Ash	1·500
	100·000

Its specific gravity is 1·3531. On elementary analysis it gave—

Carbon	70·672
Hygroscopic moisture ..	1·052
Ashes	1·500
Hydrogen	5·148
Nitrogen and oxygen ..	21·628
	100·000

It belongs apparently to the coals of the tertiary age.

Bulletin de la Societe Chimique de Paris, No. 10, May 20, 1875.

Characteristics of Glycocoll.—M. R. Engel.—Already noticed.

Presence of Anhydrous Sulphuric Acid among the Gaseous Products of the Combustion of Iron Pyrites.—M. Scheurer-Kestner.—Already noticed.

Phenylo-Sulphacetic and Ethylo-Sulphacetic Acids.—M. J. P. Claesson.—A most elaborate account of these acids, and of their principal salts.

Salts of Trimeta-Phosphoric Acid.—M. C. G. Lindbom.—The author describes the salts of soda, potash, ammonia, silver, baryta, lead, magnesia, iron (ferrous), manganese, the free acid, the double salts of baryta and soda, baryta and ammonia, baryta and potash, strontia and soda, lime and soda, magnesia and soda, nickel and soda, cobalt and soda. The author has not been able to obtain definite salts with the weaker bases.

Correspondence from St. Petersburg.—M. W. Louguinine.—M. W. Roudneff announces that on the reduction of trichloro-lactic ether there is formed as principal product, not chloracrylic ether, but dichloro-lactic ether, and probably small quantities of mono-chloro-lactic ether. M. Socoloff communicates the result of his studies on the detection of hydrocyanic acid in cases of poisoning. The acid appears to be found in the organism in the state of double salts which do not readily react with mineral acids. M. A. Wyschnegradsky has examined the condensation of isoamylen as obtained by Ermolaeff. The diamylen produced is identical with ordinary diamylen. M. G. Kasantzeff has caused hydriodic acid to act upon aceton, and upon the phoron derived from aceton. With the latter it forms $C_9H_{12}I_2O$. M. N. Menschoutkine, by acting with dilute sulphuric, nitric, and hydrochloric acids upon the product of the combination of succinimide with cyanic ether, obtains ethyl-succinuric acid. M. Th. Beilstein, by letting the pentachloride of antimony react

upon ortho-chloro-benzoic acid, forms ortho-dichloro-benzoic acid, which melts at 150°, and distils at 300°. The third part of the seventh volume of the *Journal of the Russian Chemical Society* contains the following papers:—On the combination of cyanogen with the elements of water, by M. N. Beketoff; on the isomerism of the amylens of the amylic alcohol of fermentation, by M. Flavitzky; on certain derivatives of desoxybenzoin, by M. A. Zagoumenny; on the application of sulphurous acid to the manufacture of alcohol from grain, by M. Mikoulinsky; and on the oxyiso-pyrovinic and bromo-cyano-butyric acids obtained by the aid of dibromo-butyric ether, by MM. Petrieff and Eguis.

Atomic Weight of Copper.—M. W. Hampe.—Assuming H=1, and O=15·96, the author makes the atomic weight of copper =63·013, which differs very little from 62·994, the figure found by Berzelius (*Zeitschrift fur Berg. Hutten-wesen*).

Combination of the Peroxide of Nitrogen with the Phosphate of Magnesium.—M. E. Luck.—The new compound has the composition $P_2O_6Mg_2H_2+NO_2$. It is almost insoluble in water, which it renders slightly acid. It dissolves in acids, with the escape of red vapours.

Selenite of Magnesia.—M. Hilger.—The precipitate given by selenious acid with "magnesia mixture" always contains ammonia, but in small and variable proportions (*Zeitschrift fur Analytische Chemie*, xiii., p. 394.)

Dissociation of Ammoniacal Salts in Aqueous Solutions.—M. H. C. Dibbits.—Not adapted for abstraction.

The Solubility and the Dissociation of the Bicarbonates of Potash, Soda, and Ammonia.—M. H. C. Dibbits.—The tension of dissociation of bicarbonate of potash in a saturated solution is 461 m.m. at 15°; bicarbonate of soda, 120 m.m. at 15°; 212 m.m. at 30°; 356 m.m. at 40°; and 563 m.m. at 50°; and for bicarbonate of ammonia, 720 m.m. at 15°.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 18, June, 1875.

Report Made by M. Troost, in the Name of the Committee of the Chemical Arts, on a "Siphoid Can" for Petroleum Oils, Presented by M. Moride, of Nantes.—An account of a metallic receptacle for containing petroleum and the inflammable essences, and for permitting their transport with less danger than the cans at present in use.

Report Made by M. Salvetat on the Pallet of the Painter on Porcelain for a Medium Fire, Presented by M. Francois Richard.—M. Richard, an artist on porcelain, has studied the scale of colours suitable for wares baked in a medium fire, and holding an intermediate position between hard and tender porcelains.

Limits of the Carburation of Iron.—M. Boussingault.—Taken from the *Comptes Rendus*.

Revue Universelle des Mines, de la Metallurgie, de Travaux Publics, des Sciences et des Arts Appliques a l'Industrie, March and April 1875.

This issue contains no chemical matter which has not been already noticed.

Reimann's Farber Zeitung, No. 17, 1875.

This issue contains a notice, with diagram, of an apparatus for extracting dye-woods; receipts for preventing Nicholson blues from smearing; for dyeing silk-waste a black, a white, and a yellow; for a green upon garments, both wool and mixed; and for a magenta and a light green for satins mixed with cotton.

No. 18, 1875.

This issue contains a caution against spurious qualities of commercial tannin, so-called, but containing mere traces of true tannin, and in its stead little but gallic acid and dextrin. Such preparations, however cheap, are utterly worthless, and occasion merely annoyance to the consumer.

It is rumoured that the Russian Goverment has totally prohibited the importation of aniline colours, with the exception of magenta in crystals. There are, further, receipts for a Havanna brown and a bronze upon wool; two processes for amaranth upon woollen cloth; a fast chrome green upon woollen yarn; a "Sedan" red, a bluish claret, and a bright brown on woollen garments; a green for printing on woollens; and a red-brown on a black ground on calico or muslin.

No. 19, 1875.

Boiler Incrustations.—Protzen recommends the introduction of a piece of zinc into the boiler. This determines a galvanic current which protects the iron against oxidation and corrosion, and causes the mineral ingredients of the water to be deposited as a fine loose mud, entirely preventing the formation of "crock."

The Hydrosulphite Vat.—The bisulphite of soda is used in solution at 5° B. 100 litres are poured into the air-tight agitation-cask, with 7 kilos. of zinc-powder, and stirred for twenty minutes. The liquid, which is now converted into hydrosulphite, is drawn off into a pair of large closed tubs containing milk of lime, formed of 1 part of lime to 5 of water. The liquids are well mixed in these tubs, and allowed to settle till the supernatant solution of hydrosulphite is quite clear, and slightly alkaline. Of this liquid 40 litres are taken to 1 kilo. of ground indigo. This weight of the colour—ground wet—is placed in a tub holding about 50 litres, the 40 litres of hydrosulphite are added, and the whole heated to 60°. 1 to 2 litres of milk of lime are then added, and, if needful, a few more litres of the hydrosulphite, until the mixture is a fine yellow. Lime plays an important part in the reduction of the indigo, and must be used with caution. The reduced indigo is then poured into the vat which contains merely water, bnt which, after the introduction of the indigo, must have a slightly alkaline reaction. From time to time, therefore, the addition of milk of lime is necessary. When it is required the vat loses its greenish yellow colour, and turns black. If too much lime is added the wool feels harsh when taken from the vat, and the indigo is not fixed, being capable of removal by washing with soap. In such cases acid must be added to the vat.

There are also in this issue receipts for a green, a Nicholson blue, and a crimson on waste silk; for an aniline blue on woollen piece goods; for a white, blue, green, and yellow design on a Turkey red ground; and a black on felt hats.

No. 20, 1875.

This issue contains receipts for a fast pansy on fine woollen cloth; for a dark blue on the same material; a saffranin ponceau, scarlet, and rose, and a fast aniline blue on cotton; a grey, silver-grey, and brown on cotton with the new colours of Croissant and Bretonnière; a light green, brown, and cherry-brown on jute; a dye for the "birls" in light green cloth; for printing a black, red, rose, green, yellow, and blue design, and a Prussian blue on linen.

No. 21, 1875.

The price of artificial alizarin has fallen about 35 per cent.

Hargreaves's improvements in the alkali manufacture are making rapid progress, whilst the ammonia process is not found to work well.

Chloride of barium, as a remedy for boiler incrustations, gives general dissatisfaction.

Another reduction in the value of borax has taken place, owing to the influence of the Californian deposits.

Albumen for printing purposes is becoming scarce, and a new source is greatly needed.

Hofmann's process for preparing aniline violets by means of iodide of ethyl is now generally abandoned in favour of

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Poirrier and Chappat's patent (nitrite of methyl. The blue shades are obtained by digestion with nitro-benzid in an autoclave; the red ones in a similar manner with magenta-violet.

There are also in this issue receipts for a fast aniline violet on wool; for dyeing artificial hair; for a yellow and a green on linen yarns and pieces.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in furnaces or apparatus for the manufacture of alkalies and other purposes. Christopher James Schofield, manufacturing chemist, Clayton, near Manchester, Lancaster. September 3, 1874.—No. 3025. This invention relates to furnaces with annular revolving beds and fixed roofs, as described in the Specification of patent No. 46, of 1871, and relates to constructing them with openings or spaces between the tops of the outer annular walls of the beds and the fixed roofs through which the treated materials may be removed from the beds, and the use in conjunction with such openings of inclined plates or deflectors for deflecting the materials as the beds rotate, so that the materials shall pass out over the outer sides of the beds. In some cases pillars and rings may be substituted for walls to carry the outer peripheries or edges of the roofs.

Improvements in the means and processes employed for treating and preserving animal substances for use as food. Henry Bolleter, Foley Street, Middlesex. September 5, 1874.—No. 3055. This invention has for its object improvements in the means and processes employed for preserving animal substances for use as food. For this purpose the gelatine in the meat to be preserved is solidified by means of a compound consisting of two-thirds common salt and one-third nitre, which is spread over the surface of the meat or animal matter in the proportion of about half an ounce or thereabouts to each pound of solid meat. The meat or animal matter thus treated is arranged in layers upon perforated plates or wire gauze, and placed in vessels arranged in an oven or chamber, to which heat is applied by steam or otherwise, in order to subject the animal substances thus treated for about ten or fifteen minutes to a temperature of 212° F. or thereabouts, according to the nature or quality of the meat so treated. The meat thus treated is further preserved by inclosing it in vessels hermetically sealed as is well understood.

Improvements in the mode of and apparatus for the extraction and treatment of sulphur. John Potter Wilkes, Trinity Square, Great Tower Street, London, and Anthony Aunier, Ladbroke Grove Road, Notting Hill, Middlesex. September 9, 1874.—No. 3087. The said invention relates to the extraction and treatment of sulphur, and consists chiefly:—First.—In passing steam or other vapours or gases containing oxygen and hydrogen, or either of them, through a retort or receptacle which contains the ores or other substances to be treated, the said substances being heated by the steam, vapours, or gases introduced, or by the application of heat directly to the retort. Second.—In the combustion or heating of the sulphuretted hydrogen generated by said process in combination with air or vapours, gases, or substances yielding oxygen to produce sulphurous acid. Third.—The employment of the sulphurous acid thus or otherwise produced, or vapours gases, or substances yielding oxygen in a closed chamber or vessel containing sulphuretted hydrogen, by which means the sulphurous acid or the sulphuretted hydrogen or both, are decomposed, and the sulphur precipitated. Fourth.—In the treatment as above stated of sulphurous acid or sulphur fumes however generated. Fifth.—In the treatment of sulphuretted hydrogen with nitrous compounds of oxygen by passing the same into a chamber containing a vessel or vessels or trays on which the nitrous compounds are placed for the purpose of decomposing the sulphuretted hydrogen and depositing the sulphur. Sixth.—In the novel construction and arrangement of the apparatus employed in the carrying out the said process.

Improvements in the treatment of human excrement, both solid and liquid, and also other animal urine, and in the apparatus employed therein. Bridge Baron Standen, Shipley, near Bradford, York. September 11, 1874.—No. 3122. The invention relates to improvements on means described in the Specification of Letters Patent, No. 2687, 72, by which the mixing of the matters before subjecting them to the action of the acid is more thoroughly effected. The heating chamber employed for effecting the evaporation of the watery particles are heated by steam in jackets at the lower part of them, and such matter is taken from one heating vessel after it has been acted upon for a time therein, and allowed to flow into a cooler, from which it is transferred to another or other heating vessels, until it is of a pasty consistency, when it is placed in trays and in ovens to be dried. When dried it is broken up and ground for stowage and use. The vapour from the respective heating chambers is conducted away by pipes with valves and condensed by mixture with water.

NOTES AND QUERIES.

Magnesic Chloride Cement.—Can any correspondent inform me where I can get any information about cement made by adding to magnesia a solution of chloride of magnesium or chloride of calcium, and where the coarse magnesia can be obtained?—Silex.

Hydrosulphite of Soda.—Can your readers give me any information as to how Schützenberger and Lelan's hydrosulphite of soda is made (the substance that is used in the new process of dyeing indigo-blue), as I cannot succeed with the plan of their patent?—E. R.

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THE CHEMICAL NEWS.

VOL. XXXI. No. 815.

ANALYSIS OF CHALYBEATE WATER FROM A SPRING AT SELLAFIELD, NEAR WHITEHAVEN.

By WILLIAM H. WATSON.

THE village of Sellafield is distant about 10 miles south of the town of Whitehaven, and about ¼ a mile from the sea. The water, which rapidly forms a deposit of ferric oxide on exposure to the air, issues fresh from a pipe—a gallon in about 4½ minutes,—the quantity, however, being much influenced by the wetness or dryness of the weather. The spring is in a field belonging to Mr. Addison, and at the bottom of the railway embankment of the Cleator and Egremont Company. A sample of the water, collected at 2.30 P.M., on the 2nd of June, 1875, gave on analysis the following results:—

	Grs. per Gall.
Total solid constituents	42·570
Ferrous carbonate	9·630
Manganous carbonate	1·718
Calcium carbonate	14·500
Calcium sulphate	0·583
Sodium chloride	11·975
Sodium sulphate	2·808
Magnesium carbonate	0·710
Silica	0·410
	42·324
Loss and undetermined	0·246
Total	42·570

Temperature of the water as it issued from the pipe, 59° F.

Temperature of the air, 70° F.

Another sample of the water, collected on the 21st of June, gave total solid constituents 44·66 grains per gallon; difference between the samples—due very probably to the weather—2·09 grains.

Chemical Laboratory, Braystones, near Whitehaven, July 5, 1875.

ESTIMATION OF TANNIC ACID.

By S. J. SIMPKIN.

IN decoctions of sumach, divi-divi, and similar substances tannin may be separated by precipitation with a solution of ammoniacal sulphate of copper: it is necessary that there shall be an excess of ammonia.

Extract 5 grms. of the tannin material with water and make up to 1 litre, take 10 c.c. of this decoction, acidify with sulphuric acid, add some water, and titrate with permanganate of potash. From 100 c.c. of the tannin extract precipitate the tannic acid with ammoniacal sulphate of copper, taking care that there is an excess of ammonia, and filter; the first few drops of filtrate are rejected, 10 c.c. of the filtrate acidified with sulphuric acid, watered, and titrated with permanganate.

The number of c.c. of permanganate destroyed by the solution from which the tannin has been separated, subtracted from that before removal of tannin, gives the quantity of permanganate which has oxidised tannic acid.

Bowling Dye Works, Bradford, Yorks.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from page 5).

IT has also been observed that old charcoal burns more energetically than recent, because the former has absorbed oxygen from the air, a circumstance which has been practically utilised with advantage in refining crude iron.†

Kuppelweiser recommends air rich in oxygen for treating white crude by the Bessemer process, and he is of opinion that the cost of Tessié du Motay's process would not require to be far reduced to render oxygen available for this purpose.‡ A great future appears open here for the utilisation of oxygen. Nevertheless, Le Blanc's objection cannot be overlooked, that more infusible crucibles, furnaces, &c., would be required, the cost of which would render the advantage of the process doubtful.

Turning from metallurgy to the production of light, we must admit that, since 1826, when Drummond‖ invented his oxyhydrogen light, and applied it for land-measuring and for lighthouses, no one can have questioned the value of oxygen for this purpose. As the price of the gas was reduced its application was extended, an example being especially set in America. H. Vogel,§ in the year 1870, found oxygen in successful use at New York, not merely for lighthouses, signals, and the building of houses, but also for aquatic structures and for several applications of the magic lantern. The aquatic operation in connection with the great Brooklyn Bridge over the East River, then in course of erection, were lit up with twelve oxyhydrogen lamps, which consumed daily 2000 cubic feet of oxygen.¶ Instead of lime points, the more permanent zircon cones were used with great advantage. In Paris, also, the Théâtre de la Gaité and the Alcazar were illuminated with a fairy splendour.

At the Opera House at New York,** a diagram of about 10 square metres upon a screen of damp muslin was lit up by the aid of a system of powerful lenses, whilst the lamp stood at the back-ground of the stage at the distance of 25 metres, and gave a striking effect. In conjunction with this light, the magic lantern was adopted in America to exhibit apparatus, photographs on glass, and other drawings in large lecture-halls, especially since Outerbridge discovered the way of using thin plates of gelatine for the production of lithographs or pen-drawings. The effect is easily conceived if we remember that the oxyhydrogen flame is 16½ times more brilliant than that of an ordinary burner fed with the same amount of gas.

The daily production of the New York Oxygen Company amounted in 1870 to 30,000 cubic feet, or 850 cubic metres. The gas is delivered in iron cylinders (Robert Grant's patent, New York), 9 inches in diameter and 30 inches long, which are filled with oxygen under a pressure of 20 to 30 atmospheres. The cylinder is sold at 1 dollar per cubic foot, including the oxygen contained in it at ordinary atmospheric pressure. The oxygen, on refilling, is supplied at five cents per cubic foot under the pressure of 1 atmosphere,†† an exceedingly high price, more than twenty-two times as great as Kuppelweiser's calculation, as quoted above, although Tessié du Motay's method is in use in New York.

(To be continued.)

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† *Journ. Prakt. Chemie*, ci., 397. *Bergwerksfreund*, iii., 513.

‡ Kuppelwieser, *Berg. u. Hüttenm. Zeitung*, 1873, 354.

‖ Drummond, "On the Means of Facilitating the Observation of Distant Stations in Geodetical Operations."—*Phil. Trans.*, 1826.

§ Vogel, *Ber. Chem. Gesell.*, iii., 901.

¶ Vogel says, by mistake, cubic metres.

** Morton, *Journal of the Franklin Institute*, liii., liv., lv.

†† *Deutsche Gewerbe Zeitung*, 1867, p. 18.

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ON THE ESTIMATION OF PHOSPHORIC ACID AS AMMONIO-MAGNESIAN PHOSPHATE.

By THOMAS ROBERTSON OGILVIE.

(Concluded from p. 6.)

N.—*Precipitation of P_2O_5 in Presence of a Fixed Quantity of Ammonium Oxalate, Citric Acid, Ammonium Sulphate, Oxide of Iron, Alumina, and Varying Quantities of Magnesian-Mixture.*

No.	$NH_4O,\overline{O}$	Citric Acid.	NH_4O,SO_3.	Fe_2O_3.	Al_2O_3.	Mg. Mix.	$2MgO,P_2O_5$.
	grm.	grm.	grm.	grm.	grm.	c.c.	grm.
1	1	0·5	0·25	0·035	0·013	7	0·3115
2	1	0·5	0·25	0·035	0·013	13·5	0·3245
3	1	0·5	0·25	0·035	0·013	20	0·3285

In (D-G) the influence of the presence of varying quantities of ammonium oxalate and citrate, without the addition of the metallic oxides, is shown; while in the experiments (H N) the effects are brought out of the combined presence of all the ingredients usually associated with phosphoric acid in the estimation of a superphosphate, or a mineral phosphate, containing oxide of iron and alumina.

Ammonium oxalate, in proportion to the quantity present, and when not more than 50 per cent of an excess of magnesia-mixture is used, causes the results to be low. This is of importance in the analysis of bone-ash, spent charcoal, apatite, and other phosphates containing much lime and very little oxide of iron and alumina. A certain excess of oxalate will remain after the precipitation of the lime, and with the presence of only 0·5 grm., and an excess of 50 per cent magnesia-mixture, a result (D-2) of 98·73 instead of 100 was obtained. This may be taken as the amount of error in the analysis of a phosphate of lime containing little iron, with even the best working of this process. If, however, with the same quantity of ammonium oxalate, a greater excess than 50 per cent magnesia-mixture be used, a high result will be got. Thus in (D-2) with 13·5 c.c. magnesia-mixture, 104·27 was found instead of 100.

Ammonium citrate has the same action as the oxalate. With the addition of 0·5 grm. citric acid and 7 c.c., or an excess of 50 per cent of magnesia-mixture, a result (E-2) of 98·10 was obtained; while with the same quantity of citric acid and 13·5 c.c. of mixture (as the same table shows) 102·53 was found instead of 100. Under certain conditions, therefore, the solvent action of these salts is very apparent, while under other circumstances that action is hidden by the oxalate or citrate of magnesia which comes down with the phosphate precipitate; and so one chemist by using this process in one way might be known as a "low" analyst, while another by working the same process in another fashion might be sought after as a "high" analyst.

But it is of special importance to consider the effect of citric acid as shown in the experiments in which the metallic oxides were also present. The precipitates got with 0·5 grm. citric acid in (H) were slightly yellow with oxide of iron; they were each too high and increased in weight according as the excess of "magnesia-mixture" was increased. The precipitates in (I) got in the presence of the same salts as in (H), with difference of the addition of 1 grm. of citric acid instead of 0·5 grm., were granular and free from iron. They also were slightly high, but considerably nearer the truth than the results obtained in (H).

In the case, then, of the determination of phosphoric acid in a superphosphate or a coprolite containing not more than 4·8 per cent of oxide of iron and alumina, the experiment in (J-1), equivalent to 101·10, may be accepted as indicating the least error which will occur by the use of this process. Under certain conditions, it is true, a closer result might be got, as in (K-1), viz., 100·31, but as this precipitate was yellow with oxide of iron it really came close to theory by different errors equalising each other, and it therefore cannot be accepted as satisfactory. On the other hand, by the indiscriminate use of reagents, an enormously high result may be got, as the precipitates obtained in (H-3) and (K-3), viz., 108·86 and 112·82 plainly illustrate.

O.—*Precipitation of P_2O_5 in a Boiling Solution in Presence of Varying Proportions of Magnesia-Mixture.*

No.	Mg. Mix.	(Boiling.) $2MgO,P_2O_5$.	(Cold.) $2MgO,P_2O_5$.
	c.c.	grm.	grm.
1	7	0·3160	0·3160
2	13·5	0·3230	0·3190
3	20	0·3245	0·3220

P.—*Precipitation of P_2O_5 in a Boiling Solution in Presence of Varying Quantities of Ammonium Oxalate, and Varying Quantities of Magnesia-Mixture.*

No.	$NH_4O,\overline{O}$.	Mg. Mix.	(Boiling.) $2MgO,P_2O_5$.	(Cold.) $2MgO,P_2O_5$.
	grm.	c.c.	grm.	grm.
1	0·25	7	0·3275	0·3130
2	0·50	13·5	0·3235	0·3295
3	1·00	20	0·3545	0·3270

Q.—*Precipitation of P_2O_5 in a Boiling Solution in Presence of a Fixed Quantity of Ammonium Oxalate, Citric Acid, Ammonium Sulphate, Oxide of Iron, Alumina, with Varying Quantities of Magnesia-Mixture.*

No.	$NH_4O,\overline{O}$.	Citric Acid.	NH_4O,SO_3.	Fe_2O_3.	Al_2O_3.	Mg. Mix.	(Boiling.) $2MgO,P_2O_5$.	(Cold.) $2MgO,P_2O_5$.
	grm.	grm.	grm.	grm.	grm.	c.c.	grm.	grm.
1	0·5	0·5	0·25	0·035	0·013	7	0·3320	0·3225
2	0·5	0·5	0·25	0·035	0·013	13·5	0·3065	0·3280
3	0·5	0·5	0·25	0·035	0·013	20	0·3120	0·3440

The experiments (O-Q) show the results got by precipitating the ammonio-magnesian phosphate in boiling solution in presence of various reagents. In (O-1), in which an excess of only 50 per cent of magnesia was used, the result was as correct in the boiling solution as in the cold one; but in all the other experiments the results were more or less erroneous, and in most cases even more so than in the corresponding tests done at the ordinary temperature.

R.—*Influence of Re-Dissolving Precipitates got in Presence of Magnesia-Mixture only.*

No.	Mg. Mixture.	With Reprecipn. $2MgO,P_2O_5$.	Without Reprecipn. $2MgO,P_2O_5$.
	c.c.	grm.	grm.
1	5	0·3110	0·3160
2	7	0·3125	0·3160
3	13·5	0·3150	0·3190
4	20	0·3160	0·3220

S.—*Influence of Re-Dissolving Precipitates got in Presence of Fixed Quantities of Ammonium Oxalate, Citric Acid, Oxide of Iron, Alumina, and Varying Quantities of Magnesia-Mixture.*

No.	$NH_4O,\overline{O}$.	Citric Acid.	Fe_2O_3.	Al_2O_3.	Mg. Mix.	With Reprecipn. $2MgO,P_2O_5$.	Without Reprecipn. $2MgO,P_2O_5$.
	grm.	grm.	grm.	grm.	c.c.	grm.	grm.
1	0·5	0·5	0·035	0·013	7	0·3085	0·3225
2	0·5	0·5	0·035	0·013	13·5	0·3075	0·3280
3	0·5	0·5	0·035	0·013	20	0·3010	0·3440

The precipitates got in (R) were allowed to stand for six hours, then the clear solution filtered off, the precipitates dissolved in the least possible quantity of hydrochloric acid, thrown down again with ammonia, and set aside for one hour. Those got in (P) were treated in the same way, with the difference that 0·5 grm. of citric acid was added to each as they contained a little oxide of iron. It will be observed that the pure precipitates got in (R-1) and (R-2) were slightly dissolved by re-precipitation; and although (R-3) is very near the theoretical quantity, and (R-4) exactly correct, it is apparent that the same solvent

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action took place with them as with the others, but that it is covered over by the excess of magnesia not being dissolved. In all of the experiments in (S) the precipitates were below the theoretical quantities. The interesting observation made by Parnell (CHEMICAL NEWS, vol, xxiii., 145) that the solvent action of ammonium chloride only comes into play when there is no excess of magnesia, doubtless explains why re-precipitation so noticeably lessens even the pure precipitates of ammonio-magnesian phosphates.

The conclusions to be drawn from the whole series of experiments may be summarised thus :—

1. The estimation of phosphoric acid combined with the alkalies, as ammonia-magnesian phosphate, is perfectly trustworthy and accurate when a moderate excess of "magnesia-mixture" is used.

2. The estimation of phosphoric acid combined fully with lime only, as ammonia-magnesian phosphate, is not satisfactory under any conditions. It will yield a "low" result when a moderate excess of "magnesia-mixture" is used, owing to the solvent action of the ammonium oxalate introduced in the act of removing the alkaline earth, or a "high" result when a greater quantity of "magnesia-mixture" is used.

3. The estimation of phosphoric acid combined with lime and oxide of iron and alumina, as ammonia-magnesian phosphate, is also unsatisfactory, owing to the combined action of ammonium oxalate and ammonium citrate. High or low results may be got, according to the quantities of these salts and of "magnesia-mixture" present.

4. That precipitation in boiling solution, or re-precipitation, will not fully remedy the errors incident to the use of the reagents mentioned.

5. That by the judicious use of the reagents the least error that may be anticipated in the determination of lime phosphates by this process is 1·27 per cent, and in the determination of phosphates containing oxide of iron and alumina 1·01 per cent, while by the indiscriminate use of reagents errors up to 10 per cent or 12 per cent may be introduced.

As to the special result of this investigation, I feel warranted in condemning the use of this process in the analyses of phosphates containing iron and alumina, unless in cases in which the results are expected to be merely *closely approximate*. In all analyses that are to be the basis of money valuation, or of scientific statements, the molybdate or other method should certainly precede precipitation with magnesia.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Thursday, June 26, 1875.

Professor G. C. FOSTER, F.R.S., Vice-President, in the Chair.

THE Earl of Rosse, Mr. L. Schwendler, and Mr. R. S. Brough were elected members of the Society.

Mr. W. J. WILSON read a paper on "*A Method of Measuring Electrical Resistance of Liquids.*" Great difficulty has hitherto been experienced in measuring the resistance of electrolytes on account of the polarisation of the electrodes, and most of the methods hitherto employed have aimed at reducing this to a minimum by using large electrodes and very weak or rapidly alternating currents. The determinations, however, are difficult and require to be quickly performed. The following method is easy and is free from both the above objections. The arrangement in its most simple form consists of a long narrow trough filled with the liquid to be measured, say dilute acid. A porous pot containing a zinc plate in sulphate of zinc being placed in the acid at one end of the trough, and a similar pot with a copper plate in sulphate of copper in the acid at the other end; the whole arrangement forms a sort of elongated Daniell's cell, the chief resistance of which is in the long column of acid. The circuit between the plates being completed through a resistance-box and mirror galvanometer, the current is shunted until a suitable deflection is obtained. One of the porous pots is now moved along the trough towards the other, and, as the resistance of the circuit is thus reduced by shortening the column of acid, the galvanometer deflection largely increases. The external resistance is now increased by means of the box until the deflection is reduced to the same point as at first. This resistance put into the circuit is evidently equal to that of the liquid taken out, and thus a measure of the liquid resistance is obtained. Two forms of apparatus were shown. In one, the vessels, containing sulphate of zinc and sulphate of copper respectively, formed pistons in a glass tube which contained the liquid to be examined. In the other, two pairs of concentric vessels were connected by a bent glass tube which contained the liquid under examination. The method is applicable to a great variety of liquids, and with care almost any degree of accuracy may be obtained. The chief obstacle to exact measurements lies in the fact that the resistance of liquids is greatly affected by temperature, but this difficulty is, of course, common to all methods. Mr. Wilson has been experimenting with brine and gave some of the results obtained, but he has not as yet made a sufficient number of experiments to complete a table. A mode of arranging the apparatus in a differential or bridge form was also described, but it has not been found necessary to use it; the simple circuit arrangement giving accurate results with less trouble.

Prof. FOSTER asked whether experiments had been made in order to compare this method with Wheatstone's, which differed from Mr. Wilson's as *liquid* electrodes were not used. He then described an arrangement he had adopted for measuring the polarisation of plates in a voltameter.

Prof. MCLEOD stated that he had used plates of amalgamated zinc and reversed currents to overcome polarisation. He found that some salts, chloride of zinc for instance, had points of maximum conductivity which corresponded to a definite degree of concentration.

Prof. GUTHRIE considered the research to be interesting as showing that points of minimum resistance might coincide with points of definite hydration of the salts.

Mr. WILSON, replying to Prof. Foster, stated that the chief objection to the use of metal plates is not a variation of the electromotive force of polarisation, but is due to the accumulation of bubbles of gas on the metallic surfaces.

Dr. STONE made a communication "*On Subjective Sensations of Taste.*" He drew attention to two simple experiments. The first consisted in applying a strong dilution of nitric acid to the root of the tongue by sucking it through a fine glass tube. If simple water were swallowed directly after this, a powerful sweet taste was felt. The same occurred if the acid were simply sipped; though not so quickly, from the time required to remove the acid from among the papillæ. He compared this effect to the complementary images seen in the eye after gazing at a powerfully illuminated body.

He then adverted to the taste of the galvanic current. In the well-known experiment with pieces of zinc and silver, it seemed zinc was actually dissolved in the saliva. But, if the pole of a strong battery (ten Grove's cells in this case) were applied to the nape of the neck, and the other to the forehead, besides the well-known flash of light, a powerful taste was experienced of a metallic character. It disappears on breaking contact; and for this reason, as well as from the fact that the tongue is not in the direct line of circuit, and also that there is no substance in the saliva likely, by decomposition, to cause metallic depo-

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sition, it could hardly be referred to chemical action, but must result from direct stimulation of the sensory apparatus. He thought a glimpse might thus be obtained of some correlation between the *modus operandi* of hearing and sight and that of taste. In the first case, a supplementary and automatic sensation, in the second the effect of a metallic solution, both entirely subjective, were excited, without the presence of any vapid substance. It seemed possible that both were due to molecular motion, as, indeed, had long ago been held with regard to smell; and that, perhaps, ultimately all the intermediate senses might be found to occupy positions in the gamut of vibration between the last cognisable by the ear and the first by the eye, or rather by the touch in the form of heat.

Mr. ROBERTS mentioned an instance in which sudden danger had been followed by the peculiar taste which results from the introduction of two coins into the mouth, to which allusion has already been made.

Professor FOSTER thanked Dr. Stone in the name of the Society, and expressed a hope that he would continue his suggestive and important experiments.

PROF. G. C. FOSTER called attention to the work of Prof. Everett on the Centimetre-Gramme Second (C.G.S.) system of units, which will shortly be published by the Society. It is designed to facilitate the study of the quantitative relations between the different departments of physical science by the adoption of a common system of hints. Prof. Foster explained that a committee of the British Association, which was appointed in 1872, and of which Prof. Everett was secretary, recommended the adoption of this system, based upon the metric system. The unit of *mass* being the gramme, that of *length* the centimetre, and that of *time* the second. They recommended that the unit of force be called a *dyne*, which therefore, is the force required to act upon a gramme of matter for a second to generate a velocity of a centimetre per second. The unit of work is called an *erg*, and is the amount of work done by a dyne working through the distance of a centimetre. Prof. Everett's book consists of a collection of physical data, reduced to these fundamental terms, so that no other physical magnitudes enter into the expressions, and it cannot fail to prove of the greatest possible value to Physicists.

Prof. Foster then left the chair, which was taken by Dr. Stone.

Dr. W. M. WATTS communicated a paper on "*A New Form of Micrometer for Use in Spectroscopic Analysis.*" In determining the position of lines in a spectrum by the use of a micrometer eyepiece or divided arc, it is often difficult to see the cross wires distinctly without admitting extraneous light, which, with faint spectra, frequently cannot be done. Dr. Watts has sought to overcome this difficulty by substituting some one known line of the spectrum itself for the cross wires, and to measure the positions of unknown lines by bringing this index line successively into coincidence with them. Thus, for example, the sodium line, which is present in nearly every spectrum whether it is wanted or not, may be made to move slowly along under the spectrum, and the displacement necessary to make it coincide with the lines to be measured may be determined by the readings of a micrometer screw. To accomplish this a convex lens of about 2 ft. focus is placed in front of the prism of the spectroscope, between the prism and observing telescope, and is divided along a line at right angles to the refracting edge of the prism. One half of the lens is fixed, the other half is made to slide over it by means of a micrometer screw. When the movable half of the lens is in its normal position, the only effect is to alter the focus of the telescope slightly, but when it is made to slide over the fixed half, the refraction of the prism is increased or diminished, and half of the spectrum appears to move over the other half, and the sodium line or any other convenient line of reference can be brought into coincidence with the lines to be measured. The indications of this instrument are reduced to wave-lengths by means of a series of interpolation curves from the data obtained by observations of the solar spectrum' the co-ordinates of which are wave-lengths and micrometer readings. The author considers the advantages of the instrument to be (1) great precision in results and (2) convenience in use. In illustration of the former quality he quotes 20 readings of the point at which there is coincidence of the lenses. They are remarkably concordant, the mean being 8·34, while the two extreme readings are 8·21 and 8·41.

Prof. GUTHRIE then read a paper "*On the Fundamental Water-waves in Cylindrical Vessels.*" He stated that many attempts had been made to connect wave lengths with wave amplitude, and that the most successful of these were by the Brothers Weber, who allowed a column of water to fall into one end of a long trough filled with water; and they ascertained by means of a stop-watch when the crest of the wave reached the other end. Dr. Guthrie has recently made some experiments on this subject in which he employed a series of five vessels, varying in diameter from 5·5 to 23·5 inches. The water in each was agitated in the centre by a disc of wood, by which means the vessel was made to give what Dr. Guthrie called its "fundamental note." He counted the number of times the wave rose in the centre in a minute and he found that amplitude has no influence upon the rate. It should also be observed that the wave effect is not the same as if the field were of infinite extent.

The following are the results he obtained :—

	Diameter of Vessel.	No. of Pulsations per minute.
1.	23·5 ins.	106·5
2.	17·87 „	122·7
3.	14·5 „	136·0
4.	12·5 „	146·5
5.	5·5 „	219·0

From which he deduced the curious result that a constant quantity (517·5) is obtained by multiplying the square root of the diameter by the number of pulsations. The question of depth was also carefully considered, and it was ascertained that the number of waves increases slightly with the depth.

Mr. S. C. TISLEY read a paper on a "*New Form of Magneto-Electric Machine.*" After briefly describing the machines which have hitherto been devised, he stated that the new apparatus consists essentially of an electro-magnet with shoes forming a groove, in which a Siemens' armature is made to revolve. It differs from the original machines made by Siemens and Wheatstone in the commutator, as two springs conduct the current from the cylindrical insulator, to which are attached three pieces of metal, one surrounding it for three quarters of its circumference, the second for one quarter, and between these is a third ring insulated and connected with the insulated end of the wire from the armature, and bearing two pieces of metal which are so arranged as to complete the circles of the outer pieces of metal. The armature is so constructed that a stream of water may be constantly passed through it.

A small machine constructed on this principle which, without its driving gear, weighs 26-lbs., is capable of raising 8 inches of platinum wire 8 inches long and 0·005 inch in diameter to a red heat.

The meetings of the Society were then adjourned until November.

Method of Discovering the presence of Nitrous and of Nitric Acids in Water.—Hermann Khemmerer.—The author adds first acetic acid and a solution of starch in iodide of potassium. If the water turns blue, nitrous acid is present. If it remains colourless, add a few drops of sulphuric acid. A blue colopration which darkens rapidly proves the simultaneous presence of nitrates and of easily decomposable organic matter.—*Moniteur Scientifique.*

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SOCIETY OF PUBLIC ANALYSTS.

INFLUENCE OF PHOSPHORIC AND OXALIC ACIDS ON THE COLOUR OF SULPHOCYANIDE AND MECONATE OF IRON.

By A. DUPRÉ, Ph.D., F.R.S.

DURING the discussion on Mr. Young's paper, "On the Volumetric Estimation of Chlorides, &c.," I took occasion to describe, shortly, Volhard's* admirable method for the estimation of silver and of chlorides in an acid solution. Volhard uses sulphocyanide of potassium as the precipitant, and takes persulphate of iron as the indicator. I stated, at the same time, that I had found the presence of phosphates interfered somewhat with the beauty of the reaction. I have since examined this point a little more closely, and believe that the results are not without some interest. The effect of oxalic acid on the red colour of the sulphocyanide of iron, viz., that of destroying it, is already known, but I am not aware that the other effects about to be described have previously been noticed.

If, to a dilute and moderately acid solution of a per-salt of iron, we add an equivalent proportion of a sulphocyanide, the well-known blood-red colouration is, of course, obtained. On now adding a solution of either a phosphate, pyrophosphate, or metaphosphate, or of the respective acids, the red colour may be entirely destroyed, even by the addition of comparatively small amounts of these substances. The influence of ordinary phosphates is least, the nature of the base exerting apparently no influence; pyrophosphates are more powerful; and, lastly, metaphosphates are most powerful of all. The effect of metaphosphoric acid I have found to be about five times more powerful than that of corrosive sublimate; unfortunately, it destroys the colour of the meconate as well. If not more of these substances than just sufficient for the destruction of the red colour has been added, the red colouration may, to a slight degree, be restored by the addition of either more acid or more sulphocyanide; but even the addition of a large excess of one of these has, comparatively speaking, but little influence. On the other hand, the addition of more per-salt of iron brings back the colour much more readily, and, indeed, a large excess of iron salt almost restores it to its original intensity.

It follows, from the foregoing, that, in testing for traces of sulphocyanide in liquids containing phosphates, it is necessary, either to remove the phosphoric acid, or else to add a very large excess of iron salt; and as the persulphate of iron is, in acid solutions, perfectly colourless, this latter expedient may generally suffice. I think it not unlikely that the presence of sulphocyanide in saliva has sometimes been overlooked, owing to its also containing phosphoric acid. In his titration, Volhard recommends the addition of a very large excess of iron salt as indicator, since in an acid solution the intensity of colour produced by a given proportion of sulphocyanide is the greater the larger the amount of iron present. In this way, the influence of any phosphoric acid present is also reduced to a minimum.

Oxalic acid, or oxalates, have also, as has already been noticed, the power of destroying the red colour of the sulphocyanide of iron.

Seeing the strong effect of these acids on the red solution of sulphocyanide of iron, I examined their influence on the similarly-coloured meconate, and found them equally effective in destroying the red colour of the latter. Here, also, meta-phosphoric acid had the greatest effect, next came pyrophosphoric, and, lastly, ordinary phosphoric.

Now, in the ordinary method employed for the detection of meconic acid in organic mixtures, in cases of suspected poisoning by opium, the acid is precipitated by means of acetate of lead. The meconate of lead obtained is next decomposed by means of sulphuric acid or sulphuretted hydrogen, and the solution thus obtained is tested for meconic acid by means of perchloride of iron. It will now be obvious that this method is open to grave objections. The organic liquids to be tested will almost always contain phosphoric acid, which will, of course, be obtained, together with the meconic acid, and may entirely prevent the action of the iron test if traces of meconic acid only are present, as will usually be the case. Fortunately, it is only ordinary phosphoric acid which is likely to be met with in such cases; nevertheless, it is, I think, extremely advisable to remove the phosphoric acid before testing for meconic acid. Oxalic acid, if present, would, like the phosphoric acid, be obtained together with the meconic acid, and would, like this acid, prevent the proper action of the iron test.

In the cases of pyro- or meta-phosphoric acid, the above reaction can be shown conveniently in somewhat dilute solutions only, since both these acids yield, with per-salts of iron, precipitates which are much less soluble in acids than the ordinary tribasic phosphate.

* J. Volhard, *Journ. für Pract. Chem.*, 1874, ix., p. 217.

CORRESPONDENCE.

DOUBTFUL MINERALS, &c.

To the Editor of the Chemical News.

SIR,—"Fortunately, anywhere, cats may look at kings." In my last communication, I promised to be more concise. I cannot, however, keep the promise; for Professor Dana, as you know, has taken me to task. In due courtesy to him, I am obliged to reply to the best of my ability, and the subject does not admit of condensation into chemical formulæ.

It is of the nature of Tar to get more fluent as the weather warms, and, I hope, on this time, not to offend "in criticism, whether from a literary, æsthetic, or scientific point of view."

In the sublimity of simplicity, a Tartar cat looked up at two kings, and the kings in their turn looked down at the cat. One stroked the right way, and called him "good-humoured;" the other the wrong way, and dubbed him "uncivil," creating thus, another provoking instance of the Dual nomenclature, to which I have presumptuously taken objection.

In his letter of April 9th (CHEMICAL NEWS, vol. xxxi., p. 160), Professor Dana writes:—"T. A. R. gives me more credit than is my due; and, in an uncivil way, brings me into collision on a point of trifling importance with the excellent mineralogist of the British Museum, Professor Maskelyne."

To these allegations, in a sort of legal way, I shall plead "Not Guilty, and extenuating circumstances."

The venerable Professor's letter challenges a little fencing; but before I touch a foil, allow me to premise that, if I have not already written enough to indicate the high appreciation I entertain of both these learned mineralogists, I am willing to go still further, and in frankness say that I regard them both as of Nature's true nobility. To a very high esteem for both, I add no low degree of reverence for the veteran Dana. Both have earned their titles to honourable distinction. Their titles are "Dana," and "Maskelyne;" names not in the least likely to be taken to mean either the same thing, or any other bodies, and it is my desire that nobody shall have the audacity to turn them into mutilated Greek or hybrid names for "universal use."

Initially and otherwise, perhaps, I may be taken for a very soft thing; but I have a habit of showing my respect to eminent men, and "sisters of mercy," by uncovering my head whenever I meet them. I should

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do this to Dana and Maskelyne, although they would not know me from Adam. Indeed, I half love the Basle people for once having made it a part of the education of every child to take off the hat to Daniel Bernouilli, the mathematician. It is exquisite enjoyment to pay old-fashioned proper respect to respectable people, whether "to greatness born," or not—I mean the truly noble—all those who befriend mankind.

The following are the chief points in Dana's communication:—

(1). That I give him more credit than is his due.

(2). That, in an "uncivil" way, I have brought him into collision on a point of trifling importnce with Maskelyne.

(3). That the system in mineralogical nomenclature is not of his making.

(4). That by implication I make out Bendant, Haidinger, Von Kobell, Nicol, Greg, and Lettsom, to be "all alike blockheads," because they have called copper pyrites chalkopyrite.

(5). That, in the adoption of the scientific names of minerals used in his treatise, he has simply followed the best authorities, and "the usual Law of priority."

(6). That the objection urged to names from a Greek or Latin source, is the old one of "uninformed" minds against all scientific nomenclature.

(7). That the object secured by such names is "uniformity the world over, through all languages."

(8). That nearly all recent mineralogical authors have adopted, and that "science has accepted *Chalcopyrite* for universal use," in lieu of copper pyrites.

Now since the tickle of a feather is always more or less an agreeable irritation, and "the dread and fear of kings" not being heavy on me, I propose to stick closely to the subject in hand, and, careless alike of praise or blame, plainly say what I think upon it in this reply.

In the first place, Dana heads his letter "Doubtful Minerals," and says not a word about them afterwards. About "Dual nomenclature" he scarcely touches the fringe of the argument: yet, what he has written, he has written, and, from his writing, I take the diploma of "excellent," bestowed on Maskelyne as a kind of strengthening mixture for my defence.

Dana dexterously touches my hamstring, and has a little the best of me, in one respect, in the wrestle about the fair fame of chalcopyrite. Had I selected "*Halite*" or "*Sphalerite*," for my figure of speech, possibly he would not have written at all; therefore I may good-humouredly chuckle over the fact that my experimental cablegram has been the means of bringing the two mineralogical kings into verbal, and, I hope, not uncivil, collision.

To the enumerated points of Dana's letter I venturously reply:—

(1). I cannot give him *too much* credit for his life of honourable labour.

(2). It is not appropriate to label me "uncivil" in this matter. I cannot bring my mind to consider the subject of Dual mineral nomenclature one of "trifling importance." I hold it still to be the very reverse of "trifling." But, if really trifling, then all scientific bothers should be viewed as trifles, and tangled yarn the delight of weavers.

(3). I have not hinted anywhere that Dana is "the author of the system in mineralogical nomenclature:" for literally there is in it really no system at all.

The total want of system is simply discreditable to the scientific age we live in, and to the whole body of its mineralogists. I do not, however, hesitate to declare openly that my venerated teacher has been the author of a good deal of the present "confusion of tongues" in mineralogical nomenclature, his laborious efforts to the contrary, notwithstanding.

But the goal to which I am agonising is not whether Dana or Maskelyne's nomenclature is to be, or what other system should be, preferred. The object I am feebly aiming at is to get an end put to the present inconvenient diversity of use, and now that I have wired together the only two intelligences that can readily effect this desideratum, I am quite buoyant with expectation and cheerful hope.

(4). I shall be excused for saying that it is scarcely regal to parody the speech of low intelligence, and to put "blockhead" into my hand to hurl at Bendant, Nicol, and others my superiors. I never could apply the damaging epithet to them, for all in their turn, as well as Dana, have instructed me.

It is fact that the authors cited by Dana used chalcopyrite for copper pyrites; but, it is also fact that copper pyrites was the expression used by Allan, Jameson, Chapman, Thomson, Phillips, Gmelin, Bischoff, in Ure's "Dictionary," in Watts's "Dictionary," in the recent mineralogical offshoots from Jermyn Street (of Ramsay, Rudler, and Jordan), by Maskelyne at the British Museum, and *mirabile dictu* by Dana himself prior to 1868!

I am too far off the British Museum Library, or I would ascertain by what name Dana called copper pyrites in the first, second, third, and fourth editions of his "System of Mineralogy." It is sufficient, however, for my purpose to state that in his "Manual of Mineralogy," 1863 and 1867, he uses copper pyrites always, and chalcopyrite *never!*

In 1725, Dana's authority, *Henckel*, called copper pyrites, pyrites *flavus*, although he also appears to have suggested that the adjective *flavus* should be put into Greek, as *brass*. χαλκος was thus made to depose *flavus* unnecessarily, and withal to carry an erroneous idea along with it. It will not be denied that both pyrites flavus, and copper pyrites, have the appreciative merit of vivid directness of expression, which chalkopyrite has not and never can have. A student can seize and hold forceps-like, the idea involved in them; but not so in chalkopyrite. A Folkestone man might feel inclined to take the latter for pyrites o' th' chalk. I do not say that he would do so. It would appear as useless to contend for the appropriateness of chalcopyrite, as of that hybrid "*gold-brass*," aurichalcite.

(5). I am entitled to ask who are the *best* mineralogical authorities of the past? and who instituted the law of priority? This law of priority upon which Dana lays such peculiar stress, is evidently unlike the law of the Medes and Persians, for Dana himself is not very rigid in his adherence toi t. In 1868 he rejects the

Augite of *Wern*, 1792, for Pyroxene of Häuy, 1801.

Hornblende of *Wern*, 1789, for Amphibole of Häuy, 1801.

Steatite of *Kirn*, 1794, for Saponite of *Svanberg*, 1840.

Mispickel of 1747, for Arsenopyrite of *Glock*, 1847.

Meerschaum of *Wern*, 1788, for Sepiolite of *Glock*, 1847.

Anatase of *Hauy*, 1801, for Octahedrite of *Wern*, 1803.

Pitchblende of old, for Uraninite of Dana, 1868.

Tin Pyrites of *Kirn*, 1797, for Stannite of *Dana*, 1868.

Blende of old, for Sphalerite of *Glock*, 1847.

Galena of *Pliny*, for Galenite of *v. Kob.*, 1858.

Mimetesite of *Breith.*, 1841, for Mimetite of *Haid.*, 1845.

Berzelite of *Levy*, 1837, for Mendipite of *Glock*, 1839.

Rock Salt of old, for Halite of *Dana*, 1868.

Tungstic Ochre of *B. Silliman*, 1822, for Tungstite of *Dana*, 1868.

Sulphuric Acid of old, for Sulphatite of *Dana*, 1868.

Nickeline of *Bend.*, 1832, for Niccolite of *Dana*, 1868.

Delvauxene of *v. Hauer*, 1854, for Borickite of *Dana*, 1868.

The transmutations of horn silver are interesting. It became Kerargyre under *Bend.*, 1832; Kerat under *Haid.*, 1845; Argyroceratite under *Glock*, 1847; Kerargyrite afterwards, under *Dana*, and Chlorargyrite (as now)

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under *Maskelyne*. In 1868 *Dana* put forth Ketarargyrite as the proper derivative, changed the Greek κ into *c*, and let go the word Cerargyrite for "universal use."

I may here remark that Dana has not always been faithful to his own decisions, *e.g.*, the Sylvanit of *Neck.*, 1835, was changed by Dana in 1837 to Aurotellurite, and reinstated as Sylvanite in 1868. Emplektite of *Kenng.*, 1853, was made Tannerite, 1854, and Empleĉtite, 1868. Feuerblende of *Breith.*, 1832, made Fireblende, 1850, and Pyrostilpnite, 1868. Plumbo-gummite of *Shep.*, 1835, made plumbo-resinite, 1837, and again plumbo-gummite, 1868. Melinophane of *Scheerer*, 1852, made Meliphane by *Dana*, 1867, and changed for Meliphanite, 1868.

The "limitations" of the law of priority appear to have been needlessly infringed in the following instances, viz.:—The Olivine of *Werner* for Chrysolite of de Lisle. Amber of recent centuries, for the Succinite of *Pliny*. Idocrase of *Hauy*, for Vesuvian of *Werner*, and the Sphene of *Hauy* for the Titanite of *Klaproth*. The Fluor of our lifetime for the Fluorite of *Napione*, 1797. (Dana himself using Fluor Spar familiarly in description. Syst. Min. p. 125.) Lots appear to have been drawn for precedence in the case of the Wernerite and Scapolite of *d'Andrada*, of 1800. Scapolite has since been in general use; but in 1868 Dana substituted Wernerite, although he writes familiarly of Red and Black Scapolite afterwards (Syst. Min., p. 134), and in "Manual," 1867, cites *Scapolite*, adding (p. 181) "Nuttalite, Wernerite, and Glaucolite, are varieties of this species."

Although Dana asserts the Greek language to be the most approved source of names, he occasionally compliments persons and places. Silicoborocalcite, he economically transforms to Howlite. The Binnite of *C. Heusser*, 1855 (the Arsenomelan of *Petersen*, 1866), appears to have been turned into Sartorite out of compliment to *Sartorius v. Walterhausen*, because he announced the mineral as Skleroklas+Arsenomelan. See also Dana's Tavistockite, Urpethite, Azorite, Zietrisikite, &c.

It seems barely consistent to eject the English word "*stone*" from mineralogical science, and to take up instead the Greek "*lithos*." Still less consistent to employ the artist who chiselled somehow *Bob* out of Robert, to make *ite* and *yte* out of lithos, as suffixes for universal use in mineralogical and geological nomenclature.

Yet this revolution has been effected and graciously submitted to because none are misled by it. Indeed, they have their uses, although in them the least possible is left of the original Greek, and the law of priority is scouted. But "Carbohydrogens" are *not all stones*, and it is therefore difficult to see distinctive alterations for the better in Dana's Butyrellite, Glocerellite, Brücknerellite, Succinellite, Melanellite, Retinellite, Cryptolinite, &c.

Again, *who are* the best authorities, and who is to decide, when great doctors differ?

E.g., *Dana's* Calamine (a zinc silicate) is the Smithsonite of Brooke and Miller, and of Greg and Lettsom, and the Hemimorphite of *Maskelyne*.

Dana's Smithsonite (a zinc carbonate) is the calamine of Brooke and Miller, Greg and Lettsom, and of *Maskelyne*. (A student feels dangerously safe on this ground.

(6). Here Dana does me injustice. It would indeed be absurd to object to *appropriate* scientific names from a Greek or Latin source. I have never made such an objection, and I hope I shall not live to make myself half so ridiculous. Ardent lovers of such names can flounder about in palæontology to their hearts' content, or otherwise.

The stand I make for the retention of Common Salt, Blende, Copper Pyrites, Amber, &c., is precisely for the reason assigned by Dana for his retention of Quartz, Diamond, Garnet, Gypsum, Realgar, Orpiment, &c., namely, that these words have become part of general literature, and, more or less, this may be made reasonable ground of objection against the wholesale alterations made recently by Dana in mineral nomenclature.

Although, years ago, malignant typhoid stripped my head of its hair, and took along with it a good deal of my Greek and Latin, yet I am still tolerably able to make out the derivation of words *intelligently* compounded of either of these languages; but I defy the very Pope himself, with the assistance of Gladstone and Lowe, to make head or tail as to the derivation of some of the existing skye-terrier names of minerals. I warrant they would all square at Melopsite, Pyrophysalite, Zeagonite, Sphalerite, Gymnite, Æschynite, Isopyre, Neotokite, Allophanite, Monazite, Diadochite, Euxenite, Chalkopyrites, and a hundred others. (The biting a bit off the tail of the last-named helps them but little).

I am obliged, however, reluctantly to admit, that to a very great extent my mind is still "uninformed" mineralogically, although I have been a diligent and faithful disciple of Dana nearly ever since he took to "typogram." I think I have read close upon everything mineralogical that he has published. I paid willing homage to him as to a mineralogical pope until the promulgation of his "Vatican Decrees." Finding, in 1874, that his infallibility dogma interfered seriously with the allegiance to my own lawful and gracious Sovereign, I did but adopt the Gladstonian expostulation policy, and took to toasting Maskelyne first, and Dana "first afterwards," as to mineralogical nomenclature.

(7). I am entirely in accord with Dana on this point. Pio Nono says the same of theological Latin. But protestants say important language should be "understanded of the people."

(8). On this head I am not in accord with *Dana*, for reasons already stated.

In conclusion, the "extenuating circumstances" are mainly—(1) The obligation of double-duty imposed upon me and other mineralogical students by Dana's "System of Mineralogy" (1868); (2) the natural irritation I personally felt, after waiting half-a-dozen years for a new edition of *Dana's*, at being induced by an advertisement of Trübner and Co. to purchase, for 35s., what purported to be a new edition, and finding in it only nineteen pages of supplementary matter not worth one tenth of the money.

Being only an obscure mineralogieal student, and not a teacher of science, as Dana appears to apprehend, I take the liberty now of referring to certain works of his and of Maskelyne's creation, viz.:—Dana's "Manual of Mineralogy," 1867; Dana's "System of Mineralogy," 1868; and Maskelyne's "Index to the Collection of Minerals in the British Museum," 1872.

In the "Manual" of 1867, I find the six crystallographic systems appearing in the following order:—(1) Monometric, (2) dimetric, (3) trimetric, (4) monoclinic, (5) triclinic, (6) hexagonal.

In the "System" (1868), I find the order running:—(1) Isometric, (2) tetragonal, (3) hexagonal, (4) orthorhombic, (5) monoclinic, (6) triclinic; and the following apologetic note at p. 21:—"The names monometric, dimetric, and trimetric, used in former editions of this work, have been set aside for the above, for two reasons—(1) the fact that the names want precision, the hexagonal system being as much *dimetric* as the tetragonal, and the monoclinic and triclinic as much *trimetric* as the orthorhombic; (2) the desire to promote uniformity in the language of science. The names employed appear to be the best that have been proposed, and those most generally used, and, hence, those that have the best claim for universal adoption."

I have before me just thirty-two systems of crystallography, including those of Dana, and I am bound to say that I think the system proposed by Dana in 1868 is a great improvement upon all that preceded it, although the atmosphere of hexagonal crystals is still somewhat hazy to ordinary students. But I cannot refrain from asking why the "Manual," which is largely in use in this country,

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and, I suppose, also in America, is allowed to remain in this extraordinary state of difference with the improved "System?"

In proof that dual nomenclature is not a thing of such trifling importance as Dana puts it, I beg reference to Appendix A, which is a list of names of certain mineral species which Maskelyne, in his "Index," uses at the British Museum, and for which Dana has substituted entirely different words, by resurrection and otherwise.

In Appendix B I have, once for all, given a sickening long-list of "Doubtful Minerals," to be found scattered up and down our mineralogical literature. Doubtful, in some cases, wanting only further authentic particulars; doubtful, in others, to the very verge of disbelief in their existence, either at the present or at any other time.

Just one hundred years ago, Dr. Nevil Maskelyne, the Astronomer Royal, went to the mountain Schiehallion, in Perthshire, ostensibly to weigh it; but, literally, to weigh the whole earth, and he actually did so, almost to a nicety. "The excellent mineralogist of the British Museum, Professor Maskelyne," since that time has learned a vast deal of the chemical constituents of the earth, and how delicately to measure the beautiful crystal gems of it. I would politely suggest to him this as a very fitting opportunity for observing the centenary of his celebrated ancestor's great achievement, by initiating the re-construction of mineral nomenclature, and the dispersion, or otherwise, of this host of "Doubtful Minerals."

To the revered Dana, and his talented heir apparent, Professor G. J. Brush, allow me to put forth a little of the very tenderest of provocation. I would petition in the most humble and delicate manner possible.

Re-cast your "Woolwich infant" of 1868, and try it with powder that has not been quite so long in store. The new cubic system appears a great improvement on the old. Your field-piece of 1867 can be very easily rifled. In mercy to suffering humanity, whose life, at longest, is but short, rifle the one, re-cast the other, kill or cure us, and make an end of our miseries. Agree to an honourable compromise, as regards dual nomenclature, post up to date what is known of the merits or demerits of the doubtful minerals, gavanise into fresher life the legitimate orphans, shoot down the factious pretenders, bury them decently, and let them be clean and everlastingly forgotten, and your humble petitioner will for ever pray, &c.—I am, &c.,

T. A. R.

APPENDIX A.

Allochroite, Alstonite, Alum, Amber, Anatase, Augite, Barytes, Bismuthine; Bismuth Ochre, Bleinierite, Blende (Zinc), Bog-butter, Boronatrocalcite, Bromargyrite, Calaite, Calamine, Chalybite, Chlorargyrite, Cobalt Glance, Copper Glance, Chessylite, Crocoisite, Cromfordite, Cryolite, Dichroite, Erubescite, Fluor, Galena, Glaserite, Gymnite, Hamartite, Hemimorphite, Hornblende, Idocrase, Iodargyrite, Keramohalite, Kühnite, Laumonite, Lettsomite, Lievrite, Meerschaum, Melanochroite, Mimetiste, Mispickel, Molybdic Ochre, Nickel Glance, Nitratine, Nickeline, Olivine, Onofrite, Orthite, Pennine, Phosphorochalcite, Pitchblende, Plumboresinite, Pyrites (Iron), Pyrites (Copper), Ripidolite, Salt, Scapolite, Silicoborocalcite, Sphene, Steatite, Texasite, Tungstic Ochre, Völknerite, Websterite, Wolfram, Wolfsbergite, Ytterite.

APPENDIX B.

DOUBTFUL MINERALS, REQUIRING EXTINCTION OR FURTHER AUTHENTIC DESCRIPTION.

Acanthoide, Acnite, Acrusite, Adelpholite, Ænigmatite, Alm, Almagrerite, Alumina (Native), Amausite, Amblystegite, Ambrosine, Amianthoide, Anchosine, Antholite, Antimony (Native), Antilites, Antimonophyllite, Antozon Bleiglanz, Apatoid, Apjohnite (*Glock*), Aquacreptite, Aræoxene, Argillomurite, Antimonial Arsenic (*Schultz*), Arsenic Hydride, Arsenic Glance, Aspidolite (*v. Kob.*), Atelesite, Atlasite, Ataeolite, Augelite, Bagrationite (*Hermann*), Bezoar Mineral, Bolivianite, Boloretine, Bombite, Boron (Graphitoidal), Breadalbanite, Brewsterlinite, Bucaramangite, Bucaramanga Resin, Cabocle, Cabrerite, Cadmia, Calcoferrite, Caliche, Caliphite, Calstronbaryte, Calyptolite, Canonite, Cantalite, Carnat, Carnatite, Carrolite, Casinite, Castellite, Castillite, Catalina Stone, Celestobarite, Centralasrite, Cerinite, Chalchithuitl, Chantonite, Chionit, Chladnite, Chlorite Earth, Chlorolisthene, Christianite, Chromochrite, Chromchlorite, Chrysophyllite, Claussenite, Clayite, Cobalt Nickel Glance, Cobalt Scorodite, Conichrite, Conistonite, Copperasine, Copper Diaspore, Corpse Pitchblende, Cera Spar, Cottaite, Cotton Stone, Coulobrasine, Crale de Brianzon, Crucite (*Thomson*), Crucite (*La Metherie*), Cryptolilaite, Cubanite, Cuivre Speculaire, Culebrite, Cumengite, Cuprifèrous Marlite, Cyanochroite, Cyanolite, Cyrtolite, Dalarnite, Decatrityene Decatylene, Delarnite, Delawarite, Deleminozite, Dinite, Dipyrite, Dopplérite, Dumasite, Duttenstein, Dyripe, Dysluite, Eagle Stone, Elhuyarite, Ephesite, Epiglanbite, Epiphosphorite, Erlanite, Erasibite, Eschwegite, Eucolite-Titanite, Eukamptite, Euphotide, Fanserite, Feitzue, Ferrite, Ferrocalcite, Fieldite, Fossil Caoutchouc, Fossil Carbon, Fournetite, Galapectite, Gehlenite (massive), Geyerite, Gibsonite, Grahamite, Grammatite of Aker, Granitine, Grorcilite, Grothite, Guanoxalate, Gummite (*Breith.*), Halloyrite (*St. Jean de Cole*), Hamartite, Hampshirite, Harringtonite, Harriaite (*Genth*), Hartine (*Schrötter*), Hayerine (*D. Forbes*), Heddlite, Helminth, Helmintholite, Helvetan, Hematoconite, Herderite (*Haid.*), Herrerite, Hessenbergite (*Dana*), Hopeite, Hovite, Howardite, Huyssenite, Hoerlera, Hybline, Hydrospatite, Hydrocalcite, Hydrophilite, Hydrosilicite, Hypoxanthite, Hystatique (*Breith.*), Idryl, Ildefonsite, Indian Red, Iodolite, Ioguneit, Iridium (*Krantz*), Jalpalte, Jaulingite, Jelletite, Jenzsebite, Joketan, Jollyte, Jossaite, Kabook, Kainite, Kalicine, Kaliphite, Kalyplotite, Kelfekil Tartorum, Keityoit, Kerstenite, Kevil, Kinsigite, Kir, Klapperstein, Konilite, Koodilite, Koreite, Korite, Koth, Leedrite, Lennilite, Lenzinite, Leptonemerz, Leucauterite, Leucocyclite, Lentrite, Lherzolite, Lignite Resin, Liguite, Livingstonite, Lodulite, Loganite, Luncite, Magnet (Native), Mamanite, Manganite, Marasmolite, Marcylite, Margode, Mariatite, Melaxoite, Melinite (*Gloch*), Meroxite, Mesolin, Metaxoite, Meteoric Dust, Meteorkies, Miaskite, Micarelle, Michaelsonite, Miloschite, Moffraadte, Molybdänuran, Morpholites, Mother of Diaspore (*Watts*), Mourolite, Muidan, Myelin, Mysorine, Nacrite (*Vequelin*), Nanokite, Native Coke, Native Steel, Neftgil, Neoctese, Neotype, Nepaulite, Nepholite, Nickel Vitriol (*Husf*), Nickelthoneisenzinkalicat, Nitrammite, Nitrogenous Hydrocarbon, Nitromagnesite, Noralite, Nordmarkite, Norwich Mineral, Notite, Nova Mina, Odontolite, Oktibelrite, Olafite, Oro Pudre, Oserskite, Palladinite, Paraluminite, Parasite, Parastilbite, Parophite, Passauite, Pattersonite, Pelhamite, Pencalite, Pencatite, Pencil Stone, Pessilite, Petrolene, Petthoite, Phthamite, Phyllin Glance, Phylloretine, Picrofluite, Picropharmacolite, Picrotanite, Picrotephroite, Piddingtonite, Pigotite, Pinitartigen (*Watts*), Pittinite, Plakodine (*Breith.*), Plata Verde, Plattnerite, Plesaite, Plombeine, Plombrerite, Polyhalite de Vic, Polylite, Portite, Potash Copperas, Prasilite, Prasochrome, Predazzite, Protheite, Protherite. Protobasite, Przbramite, Pterolite, Pyrophane, Pyrrholite, Rancierite, Rardionite, Ratofkite, Rauchkalk, Raumite, Refdanskite, Refikite, Reissite, Retzbanyite, Rerodanskite, Richmondite, Rionite, Roepperite, Roepperite (*G. J. Brush*), Roesnerite, Sandbergite, Santorine, Saponite (*Nichles*), Scaochite, Schapbachite, Schefferite, Schlaken, Schœnite, Schweruranerz, Scleroclase, Scolexerose, Scorilite, Scoritite, Scotine, Selenium (Native), Sericite, Sericolite, Serpentinite, Sexangulite, Shepardite, Siderochisolite, Sideroclept, Sideroferrite, Siderographite, Siderosilicate, Siderosbole, Silbeloit, Skorian, Skogbœlite, Skorolite, Slaggy Mineral Pitch, Slaggy Augite, Smelite, Soda Tungstate (E. Pool Mine), Somaite, Somnite, Spartaite, Sphenomatite, Spherite, Sphragidite, Staffelitoid, Steargilite, Steel Cobalt, Stephensonite, Stibilite, Stolpenite, Strontiasocalcite, Studerite, Suiphatite (*Dana*), Szaibelyte, Talcoid, Tanah-ampo, Tantalu Ochre, Targionite, Taugiwaite, Tauriscite, Tautocline, Tecticite, Tekoretin, Tellurite (*Nicol*), Thlerschite (*Liebig*), Thomaite, Tiger Ore, Timazite, Tinder Ore, Tisa, Traversella, Trichite, Triclasite, Trinacrite, Tuesite, Turba, Uddervallite, Uigite, Unionite (Oligoclase), Uranoniobite, Vanadic Ochre, Vanadineizenerz, Vanadin-Molybdaublei, Variolite, Variscite, Vermontite, Verrucite (*Aphoka*), Vestan, Vestan Cobalt, Vignite, Vitrinopal, Vitriolite, Lhee Voglianite, Volgerite, Wærthite, Wagite, Walmstedtite, Wasite, Wehrite, Wiserite, Wocheinite, Wodankies, Wollongongite, Xylocryptite, Xylotile, Yabicoja, Ypoleime, Yttria (Silicate), You (Chinese), Zamtite, Zavalite, Zeasite, Zeugite, Zeuxite, Zincazurite, Zinkosite, Zorodon.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 23, June 14, 1875.

Researches on the Solar Radiations.—M. P. Desains.—Not adapted for abstraction.

Synthesis of Camphors by the Oxidation of Camphenes.—M. Berthelot.—This synthesis was imperfectly effected in 1858 by means of platinum-black. In 1869 the author used pure chromic acid, and was thus able to isolate the camphor furnished by the oxidation of the camphenes in larger quantities and in a greater state of purity. M. Ribau has effected the conversion in a similar manner.

Opinion of the Commission on Lightning Conductors on a New Arrangement proposed for Powder Magazines.—The Minister (for War [illegible] the

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Academy on the project of fitting up powder magazines with ventilation-shafts, resembling chimneys. A Commission selected to investigate the question concluded that such chimneys would not become sources of especial danger in case of thunderstorms, but pointed out certain precautions to be observed in their construction. It was especially recommended that no pieces of metal should be inserted, which, if a flash of lightning struck the adjacent conductors, might give rise to induction-sparks.

Synthesis of a Terpilene or Camphenic Carbide.—M. G. Bouchardat.—The author, on submitting isoprene in sealed tubes to a temperature between 280° and 290°, for ten hours, in an atmosphere of carbonic acid, found the appearance of the liquid entirely changed. On distillation three principal products were collected,—a certain quantity of the original carbide unaltered, a carbide volatile between 170° and 185°, and products of condensation with higher boiling-points. The largest portion distils at 176° to 181°, and has the composition $C_{20}H_{16}$.

Theory of Dissolution and Crystallisation.—M. Lecoq de Boisbaudran.—A criticism on the views of M. Pfaündler, as given in the *Bulletin de la Societe Chimique*, June 5, 1875, p. 491.

Gazzetta Chimica Italiana, Anno v., Fascicolo 3, 1875.

Action of Chloride of Acetyle upon Santonic Acid and upon Santonin.—Fausto Sestini.—By the reaction of chloride of acetyl upon santonic acid, the author attains monoacetil-santonic acid, $C_{15}H_{19}(C_2H_3O)O_4$. The ether which has been employed to wash the acetil-santonic acid deposits, on evaporation, a white substance of an acid reaction, melting at 126° to 128°.

On Certain *a*-Toluylic Derivatives.—C. Colombo and P. Spica.—The authors obtain *a*-toluylic sulphamide in colourless prismatic crystals, insoluble in water, but soluble in alcohol and ether, and melting at 98°, whilst its isomer—obtained from paratoluic nitrile—melts at 168°.

Formation of Sugar in Fruits.—M. Mercadante.—In the first period of their existence fruits behave like leaves, decomposing carbonic acid under the influence of the sun's rays, and giving out oxygen. In the second period they absorb oxygen and give off carbonic acid. In the third the sugar which they contain passes into the alcoholic fermentation. On the 20th of May the author began to determine the acidity and the sugar in green plums. The acidity and the sugar were found to increase very sensibly. The branches contained no other acid than the malic, accompanied by pectic and gummy matters. The fruit behaved exactly like leaves with respect to the air, giving out oxygen by day and absorbing carbonic acid. Continuing his analyses he found that the maximum acidity was when the fruit began to give off carbonic acid by day. It contained then 2·76 of malic acid in 100 of pulp. The sugar is derived from the prolonged action of the malic acid upon the gummy matter, which in the earlier analyses amounted to 6·21 per cent of pulp, but in the second to 3·34, at which quantity it remained nearly constant, 3·27 per cent of gum being still found on July 18. The successive changes in the amounts of sugar and malic acid are shown in the following table:—

	Sugar.	Malic Acid.
June 20	16·52	2·76
„ 24	16·64	2·46
„ 30	16·78	2·16
July 4	17·048	1·57
„ 12	17·38	0·82

The acids themselves thus appear to be transformed into sugar.

New Method of Determining the Tannic Acid in Wines.—Antonio Carpene.—The author precipitates the tannin with ammoniacal acetate of zinc containing a large excess of ammonia.

Justus Liebig's Annalen der Chemie.
Heft 1, May 26th, 1875.

Investigations on Hyopochlorous Acid and Euchlorines.—L. Pebal.—The author concludes from his experiments that the views of H. Davy and Gay-Lussac, as to composition of hypochlorous acid is correct. The molecular weight of the gaseous substance, putting that of hydrogen $H_2=2$ is = 67·29, and its molecular formula is ClO_2. The boiling point of liquid hypochlorous is +9°, and not about 20, or even 32°. Euchlorine is a mixture of ClO_2 and free chlorine. The relative proportions depend on the mode of its preparation. Millon's conclusions as to the existence of a compound Cl_6O_{13} depend on erroneous assumptions.

Application of Quantitative Spectral Analysis to Methods of Titration.—K. Vierordt.—Reserved for insertion in full.

Reaction of Bromide of Ethylen with Dilute Alcohol in Presence of Acetic Glycol-Ether.—Eugene Demole.—Not adapted for abstraction.

Communications from the Griefswald Laboratory.—These consist of a paper on a new amidosulphotoluolic acid, by Dr. M. Hayduck; a memoir on nitrosulphobenzolic acids, by H. Limpricht; on the amidosulphobenzolic acids, by H. Limpricht; on *a*-amidosulphobenzoic acid, by Dr. A. Berndsen; and on γ-amidosulphobenzolic acid, by A. Berndsen and H. Limpricht.

On Octylactinic Acid and its Nitrile and Amide.—E. Erlenmeyer and O. Sigel.

Origination of Amidocaprylic Acid.—E. Erlenmeyer and O. Sigel.—These two papers do not admit of useful abstraction.

Moniteur Scientifique du Docteur Quesneville, June, 1875.

Chemical Products at the Vienna Exhibition.—M. E. Kopp.—In treating of improvements in mineral colours the author mentions that the arseniate and arsenite of alumina are now extensively used in the preparation of lakes instead of free alumina, yielding products more pure and brilliant, but objectionable from a sanitary point of view. The madder preparations and artificial alizarine and its allies are treated at great length. Madder from Monte Video is described as having made its appearance in the market, and is said to be of very good quality.

Nature of Chloride of Lime, and on its Spontaneous Decomposition.—M. O. Opl.—From this lengthy paper we extract for the present merely the author's practical conclusions. He maintains that for the production of a good chloride of lime the temperature of the chambers must be as low as possible, winter being always found the most favourable season for the manufacture. In hot chambers, strong chloride of lime cannot be produced, as it heats readily and is decomposed. At a temperature of production of 15° Reaumur, chloride of lime differs in consistence and appearance from such as is obtained at 25°. The former constitutes, in the chamber, a firm bed, which may be crushed into a fine, dry powder, whilst the latter is soft and damp, and gives off a strong odour of chlorine. To prepare a strong and stable chloride, chlorine should be used free from hydrochloric acid and carbonic acid, and should enter the chamber as cold as possible. The hydrate of lime should be very pure, and should be mixed with as much water as can be added without inconvenience in sifting. The chambers should be kept during the absorption at as low a temperature as possible, not exceeding 20° R., and should have a shape which admits of easy cleaning. After removing the chloride of lime from the chambers, it should be left in chests fitted with covers, and should be often turned over, so that its temperature may fall at any rate to 17° R. before it is packed up in casks.

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Assay of Type Metal and of Alloys used as White Metal.—M. A. G. Pouchet.—This paper does not admit of useful abstraction.

Observations on the Analysis of Nitrogenous Matter used as Manure.—M. A. Bobierre.—The author points out that in the soda-lime process ammonia may be dissociated by the application of too high and prolonged a heat, and the amount of nitrogen may consequently be found too low.

New Method of Analysis by Means of Standard Liquids.—M. F. Jean.—Reserved for insertion in full.

Modification of the Liquids of Fehling and Barreswill, used for the Determination of Glucose.—M. P. Lagrange.—The author proposes the following formula :—

Dry neutral tartrate of copper ..	10 grms.
Pure caustic soda..	400 „
Distilled water	500 c.c.

It is not affected by diffused light. The tartrate of copper is obtained by decomposing sulphate of copper with neutral tartrate of soda. The precipitate is washed by decantation and dried at 100°.

Method of Analysing Cheese. — Neubauer. — Not suitable for abstraction.

Assay of Cloth Dyed Turkey Red.—Armand Müller·—The author applies for this purpose the method proposed by V. Wartha for obtaining alizarin in a state of purity. Wartha treats the dyed goods in the water-bath with a mixture of alcohol and strong hydrochloric acid. To the extract he adds potash, and filters off the rich violet-purple precipitate produced, which he then washes and decomposes on the filter with dilute hydrochloric acid. The yellowish-orange mass thus obtained is washed, dried, and sublimed. The author, repeating Wartha's experiments, observed that when swatches of cloth were placed in the same extraction bath, the solution of the colouring matter required different lengths of time according as they had been dyed at different establishments. A more attentive study of this phenomenon led to a result no less interesting than unexpected—that the time necessary for decolouration does not vary with the quantity of alizarin, but is directly proportional to the resistance of the colours to light, carbonate of soda, soap, acids, and oxidising agents, and depends, therefore, on the nature of the mordant employed. Further experiments showed that Turkey red resisted longer or shorter as it contained more or less alumina; whilst dyed cloth, from which it was possible to remove a certain quantity of the known compound of fat and alizarin, were much less solid. The author does not hold that the use of oil makes the colour fugitive; but he concludes that oil cannot brighten the red until it has been brought to that still unknown state of oxidation in which it is no longer soluble in ether, and that a residue of unsaponified fat has an injurious action, especially as regards the influence of light. To execute the assays, the author takes equal weights of the goods to be tested, and plunges them in a bath of 10 vols. alcohol at 96 per cent. and 1 vol. hydrochloric acid at 1·18 spec. grav. The mixture, which should be used in large quantities, is slowly heated to about 50°. The exact time for the total discharge of the colour of each swatch is carefully noted.

Les Mondes, Revue Hebdomadaire des Sciences.
No. 4, May 27, 1875.

Specific Inductive Power of Insulants.—F. Rosetti.—The author holds that this power depends on a state of electric polarity, which the molecules of the body assume during the induction. This state of polarity is produced by the induction current which precedes the electric induction itself, and is transmitted across the non-conductive mass by an *actio in distans* between adjacent molecules. The formula of Ohm includes also the laws of condensers, and may be employed with advantage to determine the specific inductive power of insulators. In this manner the specific power of glass is found to be 3·45; of spermaceti, 2·18; of ebonite, 2·05; of sulphur, 1·81; that of air being taken as unity.

Internal Latent Heat.—M. Avenarius.—The author has repeated the experiments of Gagniard-Latour.

No. 5, June 3, 1875.

This issue contains no chemical matter.

No. 6, June 10, 1875.

Electric Illumination of Railways and Ships.—M. Emile Girouard.—The electric light has been successfully employed on the Moscow and Kursk line in Russia.

A Perfect Process for Bleaching all Colouring Matters.—As the details of this process are withheld it is impossible to judge of its "perfection."

Chemistry of the Soda Manufacture.—A notice of Stevenson and Williamson's process.

MISCELLANEOUS.

Royal United Service Institution.—A lecture was recently delivered at this Institution (7th ult.) "On the Methods of Ascertaining the Relative Value of Coals for Naval Purposes," by Edward Eckersley, chief engineer, R.N. The chair was occupied by Admiral Sir Henry Codrington, K.C.B. The Lecturer said that naval officers were sometimes placed in positions in which it would be beneficial if they could form a just estimate between different qualities of coal; he then described, and experimentally illustrated, a few of the methods in which scientific men deal with this subject, coupled with his own experience and observation. In the hands of ready manipulators the Admiralty or other large purchasers of coal had, in Mr. Lewis Thompson's calorimeter, a ready and approximate means of testing the evaporative value of different kinds of coal. Combined with its aid, practical men would find the tests for water, ash, and the litharge test for carbon, to be sufficient. The water-oven, the improved calorimeter, and other necessary apparatus for the purpose could, and ought to be, fitted in our flagships. In the discussion which followed, and was taken part in by Admiral Codrington, Mr. Tuck, R.N., the Secretary, and others, an opinion was expressed, and received with marks of much approval by the meeting, that the Admiralty might be induced to take the matter up, first, with reference to the examinations of engineer-students on this subject, and that chief-engineers of the Royal Navy should be required by the Admiralty to make a more special study, at the Royal Naval College, Greenwich, and at the Royal Laboratory, Woolwich, of this important question of how to adopt the most efficient means of testing steam-coal when afloat, according to the most approved methods; and, secondly, in regard to supplying steamships with testing-apparatus.

NOTES AND QUERIES.

Value of Fuel.—Would any of your correspondents kindly tell me the method which is now adopted for determining the pyrometric value of fuel, and the absolute amount of heat evolved by various kinds of fuel? How is the mechanical equivalent calculated from the above data?—W. C. Parsons.

Manufacture of Oils.—Can any reader inform me of the best publication on the manufacture of oils, &c.?—W. H. B.

Decolorisation of Blood Albumen.—(Reply to G. Jones.)—In reference to the decolorisation of blood albumen, a very cheap and simple method is to add, to a solution of blood albumen at 110° F., an eighth part of turpentine. By allowing this to stand two or three days, and stirring occasionally, a solution is obtained of a very good colour, and which, when dried on a glass plate, gives an albumen of a much lighter colour than the original.—William Browning.

Erratum.—Page 275, line 39 from top, *for* "nitric" *read* "nitrous."

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THE CHEMICAL NEWS.

Vol. XXXI. No. 816.

ON RELATIONS AMONG THE ATOMIC WEIGHTS OF THE ELEMENTS WHEN ARRANGED IN THEIR NATURAL ORDER.

By JOHN A. R. NEWLANDS, F.C.S.

It is a singular circumstance that handbooks of Chemistry which contain tables of various data, such as boiling-points, melting-points, specific gravities, latent heat, specific heat, conducting powers for heat and electricity, &c., in the natural order should, in reference to the atomic weights of the elements, give no similar table, but merely contain an alphabetical arrangement.

The principal object of the present paper is to call attention to this striking omission, which will doubtless be soon remedied by the introduction into treatises on Chemistry, of a table of the atomic weights of the elements in their natural order, in addition to the usual convenient alphabetical arrangement.

I now offer a Table of this description; the different columns of the table give as follows:—1st, the ordinal number; 2nd, the symbol; 3rd, the atomic weight; and 4th, the difference between each atomic weight and that preceding it. All the atomic weights except that of thallium, and also five marked as doubtful, viz., those of yttrium, didymium, cerium, erbium, and lanthanum, are taken from Fownes's "Chemistry," 11th edition, 1873.

Table I.—*Elements in Order of Atomic Weight.*

No.	Symb.	At. Wt.	Diff.	No.	Symb.	At. Wt.	Diff.
1	H	1	—	33	Zr	89·6	1·6
2	Li	7	6	34	Nb	94	4·4
3	Be	9·4	2·4	35	Mo	96	2
4	B	11	1·6	36	Rh	104·4	8·4
5	C	12	1	37	Ru	104·4	0
6	N	14	2	38	Pd	106·6	2·2
7	O	16	2	39	Ag	108	1·4
8	F	19	3	40	Cd	112	4
9	Na	23	4	41	In	113·4	1·4
10	Mg	24	1	42	Sn	118	4·6
11	Al	27·4	3·4	43	Sb	122	4
12	Si	28	0·6	44	I	127	5
13	P	31	3	45	Te	128	1
14	S	32	1	46	Cs	133	5
15	Cl	35·5	3·5	47	Ba	137	4
16	K	39·1	3·6	48	Di	138 (?)	1
17	Ca	40	0·9	49	Ce	140 (?)	2
18	Ti	50	10	50	Er	178 (?)	38
19	V	51·2	1·2	51	La	180 (?)	2
20	Cr	52·2	1	52	Ta	182	2
21	Mn	55	2·8	53	W	184	2
22	Fe	56	1	54	Au	197	13
23	Ni	58·8	2·8	55	Pt	197·4	0·4
24	Co	58·8	0	56	Ir	198	0·6
25	Cu	63·4	4·6	57	Os	199·2	1·2
26	Zn	65·2	1·8	58	Hg	200	0·8
27	As	75	9·8	59	Tl	203·6	3·6
28	Se	79·4	4·4	60	Pb	207	3·4
29	Br	80	0·6	61	Bi	210	3
30	Rb	85·4	5·4	62	Th	235	25
31	Sr	87·6	2·2	63	U	240	5
32	Y	88 (?)	0·4				

On carefully examining this table many interesting facts may be observed, and a few of these will now be briefly indicated. If we start with the fifth element we find that it and all the following elements up to and including No. 17, are elements of great importance from their being widely diffused in the earth, the ocean, or the atmosphere, forming a large proportion of the earth's crust, and being essential to animal and vegetable life. Their very names recall the constituents most frequently mentioned in analyses of soils, waters, &c., as carbon, nitrogen, oxygen, fluorine, sodium, magnesium, aluminium, silicon, phosphorus, sulphur, chlorine, potassium, and calcium. If to these we add hydrogen and iron such a list will include all the most important elements. If we omit fluorine, which is perhaps not so important as the rest, the list will comprise two representatives of each of the seven principal groups of elements, thus:—

(See Chemical News, vol. xxvi, p. 19.)

Monads—Sodium and potassium.
Dyads—Magnesium and calcium.
Triads—Aluminium and iron.
Tetrads—Carbon and silicon.
Triads (or pentads)—Nitrogen and phosphorus.
Dyads (or hexads)—Oxygen and sulphur.
Monads (or heptads)—Hydrogen and chlorine.

Another remarkable circumstance to which I first called attention in the Chemical News, vol. x, p. 94 (August 20, 1864), is the fact of a simple relation existing between all the known elements when arranged in the natural order of their atomic weights. This fact may be perhaps most simply stated in the following manner:—"Elements belonging to the same group stand to each other in a relation similar to that between the extremes of one or more octaves in music." Thus, if we commence counting at lithium, calling it 1, sodium will be 8, and potassium 15, and so on. To save the trouble of counting in each individual case, and also to render the relationship obvious at a glance it is convenient to adopt a horizontal arrangement, as in Table II. (see next page).

In this table the unoccupied spaces may be filled up by elements at present undiscovered, or even by known elements whose atomic weights have not yet been accurately determined. Although the position occupied by certain of the elements is open to dispute, this table will yet be found to give a good general idea of the chief Chemical Groups, whilst preserving the natural order of the atomic weights.

The quantivalence of the elements on the different horizontal lines is usually as follows:—

Line *a* — Monads.
" *b* — Dyads.
" *c* — Triads.
" *d* — Tetrads.
" *e* — Triads, (or pentads.)
" *f* — Dyads, (or hexads.)
" *g* — Monads, (or heptads.)

There are however several exceptions to this rule.

It frequently happens that the atomic weights of allied elements differ by about 16, or some other multiple of 8, as in the following cases:—

Lithium, 7 + 16 = Sodium, 23
Sodium, 23 + 16·1 = Potassium, 39·1
Magnesium, 24 + 16 = Calcium, 40
Carbon, 12 + 16 = Silicon, 28
Oxygen, 16 + 16 = Sulphur, 32

Other examples of the same fact may be found in papers by the author in the Chemical News, vol. vii., p. 70., Feb. 7, 1863, and vol. x., p. 59, July 30th, 1864.

If the atomic weights of the elements really followed the strictly natural order, they would coincide with their ordinal numbers, provided, of course, that the atomic weight chosen as the unit was the true unit, and not some multiple or fraction of the true unit.

Now, granting that the eighth element reckoning from a given one, such as potassium from sodium, is the next member of the same group, their atomic weights should, if following the natural order, differ by 7, just as their ordinal numbers differ by 7, whereas the actual difference is 16·1; so that the atomic weights are equal to the natural numbers multiplied by 2·3, for $7 \times 2{\cdot}3 = 16{\cdot}1$.

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TABLE II.—*Elements in Order of Atomic Weight.—Horizontal Arrangement.*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
a.	—	Li 7·0	Na 23·0	K 39·1	—	Cu 63·4	Rb 85·4	—	Ag 108·0	Cs 133·0	—	—	Au 197·0	—	—	—
b.	—	Be 9·4	Mg 24·0	Ca 40·0	—	Zn 65·2	Sr 87·6	—	Cd 112·0	Ba 137·0	—	—	—	Hg 200·0	—	—
c.	—	B 11·0	Al 27·4	—	Fe 56·0	—	Y 88·0(?)	—	In 113·4	Di 138·0(?)—	Er 178·0(?)	—	Tl 203·6	—	—	
d.	—	C 12·0	Si 28·0	Ti 50·0	—	—	Zr 89·6	Rh 104·4	Sn 118·0	Ce 140·0(?)—	La 180·0(?)	Pt 197·4	Pb 207·0	—	Th 235·0	
e.	—	N 14·0	P 31·0	V 51·2	—	As 75·0	Nb 94·0	Ru 104·4	Sb 122·0	—	Ta 182·0	Ir 198·0	Bi 210·0	—	—	
f.	—	O 16·0	S 32·0	Cr 52·2	Ni 58·8	Se 79·4	Mo 96·0	Pd 106·6	Te 128·0	—	W 184·0	Os 199·2	—	—	U 240·0	
g.	H 1	F 19·0	Cl 35·5	Mn 55·0	Co 58·8	Br 80·0	—	—	I 127·0	—	—	—	—	—	—	

If, therefore, we divide all the atomic weights by 2·3, or, what amounts to the same thing, if we make a table of the atomic weights taking that of sodium as 10, the atomic weights so obtained will be found to approach pretty closely to the natural order, especially when we compare the differences between elements in such parts of the list as are probably more complete than the others.

In Table III. such a list is given, and although no one would wish to abandon for most purposes the ordinary atomic weights founded upon hydrogen as unity, still it is both interesting and instructive to regard such familiar data from a new point of view.

TABLE III.—*Elements in Order of Atomic Weight, taking the Atomic Weight of Sodium as* 10.

No.	Symb.	At Wt.	No.	Symb.	At. Wt.
1	H	0·435	33	Zr	38·96
2	Li	3·04	34	Nb	40·87
3	Be	4·09	35	Mo	41·74
4	B	4·80	36	Rh	45·39
5	C	5·22	37	Ru	45·39
6	N	6·09	38	Pd	46·35
7	O	6·96	39	Ag	46·96
8	F	8·26	40	Cd	48·70
9	Na	10·00	41	In	49·30
10	Mg	10·43	42	Sn	51·30
11	Al	11·91	43	Sb	53·04
12	Si	12·20	44	I	55·22
13	P	13·48	45	Te	55·65
14	S	13·91	46	Cs	57·83
15	Cl	15·43	47	Ba	59·57
16	K	17·00	48	Di	60·00 (?)
17	Ca	17·39	49	Ce	60·87 (?)
18	Ti	21·74	50	Er	77·39 (?)
19	V	22·26	51	La	78·26 (?)
20	Cr	22·70	52	Ta	79·13
21	Mn	23·91	53	W	80·00
22	Fe	24·35	54	Au	85·65
23	Ni	25·57	55	Pt	85·83
24	Co	25·57	56	Ir	86·09
25	Cu	27·57	57	Os	86·61
26	Zn	28·35	58	Hg	86·96
27	As	32·61	59	Tl	88·52
28	Se	34·52	60	Pb	90·00
29	Br	34·78	61	Bi	91·30
30	Rb	37·13	62	Th	102·17
31	Sr	38·09	63	U	104·35
32	Y	38·26 (?)			

In conclusion, I have only to add a few remarks, which are unfortunately rendered necessary by the way in which some writers persistently ignore all mention of the names of their co-labourers in science, whether in connection with theoretical or practical questions.

The grand point I have contended for, and do contend for, is the existence of a simple relation among the elements when arranged in the order of their atomic weights. This fact was published by me in the CHEMICAL NEWS for August 20th, 1864, vol, x., p. 94. I again called attention to it in the CHEMICAL NEWS for August 18th and 25th, 1865, vol. xii., pp. 83 and 94.

On March 1st, 1866, I read a paper on the subject before the Chemical Society; and at that time the mere notion of anyone even seeking to find a simple relation among the elements when arranged in their natural order was looked upon as so absurd that one of the most distinguished members of the Society asked me "if I had ever examined the elements according to the order of their initial letters." (See CHEMICAL NEWS, vol. xiii., p. 113).

My paper was returned to me as "not adapted for publication in the Society's Journal." Seven years later, in the *Journal of the Chemical Society* for June, 1873, appeared a paper by M. L. Meyer, in which reference is made to M. Mendeljeff as having shown that certain properties of the elements appear "as a regular periodical function of the atomic weight, if the elements are arranged in the natural system, or according to the numerical values of their atomic weights." I at once wrote a letter to the Secretary of the Chemical Society, claiming priority in this matter, giving the dates of my various papers on the subject, and in conclusion asking "as a simple matter of justice, the insertion of this brief note in the Society's Journal." This note was read before the Society on June 19th, 1873, and the President (Dr. Odling) then said "that the reason why my paper on this subject in 1866 had not been published by the Society was that they had made it a rule not to publish papers of a purely theoretical nature, since it was likely to lead to correspondence of a controversial character."

On my remarking that M. L. Meyer's paper was of a purely theoretical character, I was told that "it was not inserted in the body of the Society's Journal, but only in the Abstracts from other journals; and that, at any rate, I had the CHEMICAL NEWS "to refer to as to what I had written upon the subject." It remains to be said that though the title of my note was printed, the note itself was not inserted either in the body of the Society's Journal or in the Abstracts from other Journals.

London, June 18, 1875.

CALCIC HYPOCHLORITE FROM BLEACHING-POWDER.*

By CHARLES T. KINGZETT, F.C.S., &c.

IN bringing before the Chemical Society the following observations, in their present very imperfect condition, I feel justified by only one consideration, viz., that of my inability to pursue these experiments for some time to come. I therefore hope that the interest and importance that is attached to them will prove sufficient to atone for their incompleteness.

The older view of bleaching-powder, and that shared by Berthollet, was that it is a direct union of chlorine with the base, $CaO.Cl_2$.

Miller and Muspratt regarded it as a peroxide in which oxygen was replaced by chlorine, $Ca\begin{cases}O\\Cl_2\end{cases}$.

Fresenius regards it as a mixture of hypochlorite and basic chloride of calcium, $CaCl_2O_2+CaCl_2.2CaO+4H_2O$ (see Richardson and Watts's "Technology," vol. i., p. 400).

Gay-Lussac considered it to consist of a mixture of chloride and hypochlorite of calcium, $CaCl_2O_2+CaCl_2$, and, leaving out of consideration the excess of lime, this is still the popular view.

Crace-Calvert described experiments in 1872 (*Compt. Rend.*, May 27th, 1872) which led him to regard bleaching-powder as a mixture of one part hypochlorite to two parts of chloride of calcium, $CaCl_2O_2+2CaCl_2$, but, as

* From the *Journal of the Chemical Society*, May, 1875. With additional notes.

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Kolb has shown the methods employed in these experiments to be faulty, the conclusions may be dismissed.

Moreover, recently, Goepner (*Dingler's Polytech. Journ.*, 209, 204) published a paper in which he states bleaching-powder to be a simple combination of lime and chlorine. This paper has been criticised by Schorlemmer in a note read before the Manchester Literary and Philosophical Society. We are thus reduced to Gay-Lussac's view of this body; but notwithstanding this, the question whether the chloride and hypochlorite of calcium exist in chemical combination or only in the state of mixture, is one still left for solution.

Odling looks upon this body as a hypochlorite and chloride at the same time, and thus represents it—

$$Ca\begin{cases}Cl\\OCl\end{cases},$$

and this view is supported both by theoretical considerations and by experiments. The theoretical consideration I allude to is that which regards calcium as a dyad; and the experiments are those which show that alcohol does not extract chloride of calcium from bleaching-powder, whereas by treating it with water, the excess of chloride of calcium is first removed, and after that chloride and hypochlorite are extracted together in the proportions required by the above formula.

If it be granted that I have obtained hypochlorite of calcium from a solution of bleaching-powder in the manner presently shown, then we must conclude either that water breaks up this double combination, if such it be, into the free bodies, or else that bleaching-powder itself is but a mixture of them (a conclusion not supported by other considerations). *Therefore, bleaching-powder in such a case, has the formula assigned to it by Odling, but the combination is so feeble that water destroys it.* As regards hypochlorite of calcium, so far as I can learn, it seems to be known only in a state of mixture with chloride of calcium.

There is, however, a statement in Gmelin's "Handbook," vol. ii., p. 300, that Marchand found pure hypochlorite to be formed when a mixed stream of chlorine and oxygen was passed through calcic hydrate (*Journ. pr. Chem.*, xvi., 48). But even this statement is called in question, and is very doubtful, whilst it seems to be a fact, that *hypochlorite has never before been obtained in the solid state.*

I was induced to make the following experiments by an observation which I made four years ago, when needle-shaped crystals were formed in a saturated solution of bleaching-powder, which had been exposed during a frosty night. Twelve months ago I repeated this experiment in the following manner:—

Experiment 1.—One pound of bleaching-powder was exhausted with water, and the solution after being filtered was left to itself for three weeks; but no crystals were thus obtained. The solution in a bottle was now exposed to a freezing mixture of ice and salt, when the whole froze to a solid mass, which was broken up by agitation and thrown upon a filter. The mass gradually thawed, leaving on the filter feather-like crystals, some of which were nearly an inch long. They were freed from mother-liquor by pressure between folds of blotting-paper, and weighed 0·9 grm.

On replacing them in water, carbonate of calcium remained undissolved.

The solution evolved chlorine with acids, and contained calcium. Moreover, the pressure-dried crystals evolved a powerful odour of hypochlorous acid.

Experiment 2—was made after an interval of six months on a different specimen of bleaching-powder. Moreover all the remaining experiments were made with the same solution as that which furnished the present experiment.

Two pounds of powder were thoroughly digested in the cold with a litre of water, and after standing and shaking for six or seven days, the solution was filtered and bottled.

100 c.c. were now exposed to a freezing mixture for two hours, but the cold was not sufficiently intense to freeze the solution, and no crystals were thus obtained. The solution was now evaporated in a vacuum over sulphuric acid and potash. After forty hours a dense crystallisation formed on the bottom of the dish. The mass was, therefore, filtered and rinsed once or twice with small quantities of water, then somewhat pressed between folds of paper and dissolved in water. The solution had the following properties.

On exposure to the air a deposit of calcic carbonate occurred, and the solution emitted a suffocating odour of hypochlorous acid. It contained chlorine and calcium, and evolved free chlorine with strong hydrochloric acid. It rapidly peroxidised MnO to MnO_2, and had a very powerful bleaching action.

The total weight of crystals obtained as described was 4 to 5 grms., and they were insoluble in alcohol: chlorate is readily soluble.

Experiment 3.—At first I thought freezing was necessary for the production of these crystals, but it was subsequently found that simple evaporation in a vacuum was sufficient.

Another portion (200 c.c.) of bleaching-powder solution was taken and evaporated in a vacuum over sulphuric acid and caustic potash. After eight days, a rapid crystallisation occurred; the crystals were removed, and the clear mother-liquor further evaporated, when a second large crop of crystals was obtained.

Examination and Analysis of First Crop of Crystals.

They were rapidly washed on a small filter with small but repeated quantities of water, whereby more than two-thirds were re-dissolved. The washing has to be effected rapidly, as the substance quickly destroys the paper.

The crystals were now fairly dried by pressure between folds of paper, and found to weigh nearly 2 grms.

Here I may remark that from the time the crystals are removed from the solutions, all operations must be conducted with the utmost celerity, as decomposition immediately occurs, with loss of either chlorine or hypochlorous acid, &c.

0·7820 grm. of the body was weighed out in a platinum crucible, and caustic soda (made from pure metal) poured over it; a little saltpetre soda mixture (to increase the bulk) was now added, a thorough mixture effected, the whole evaporated to dryness, and *fused well*. The melted mass was dissolved in nitric acid, and the calcium estimated in solution by the oxalate method, and the chlorine in the filtrate as ordinarily. This gave 0·203 grm. CaO = to 18·542 per cent Ca, and 0·9548 grm. AgCl = to 30·205 per cent Cl.

Now if Ca stood to Cl as Ca : Cl_2, then 18·542 Ca requires 32·91 Cl. It is therefore evident that notwithstanding the haste made with the determinations, a decomposition had occurred equal to the loss of 2·7 per cent chlorine.

0·3150 grm. of the substance heated to 100° C. till the weight was constant, weighed 0·1912 grm. It had therefore lost 60·7 per cent by weight, while the residue contained much carbonate of calcium, and gave on treatment with nitric acid an evolution of a chlorinated body, so that the chlorine could not be estimated in it.

Now hypochlorite of composition $CaCl_2O_2{,}4H_2O$ would give 18·604 per cent Ca as against 18·54 found
33·02 „ Cl „ 30·20 „
and supposing all the water and all chlorine to be evolved at 100° C. in the air-bath, 66·51 per cent loss as against 60·70 found, and, as shown above, all the chlorine was *not* expelled, doubtless from formation of a little chlorate.

Examination and Analysis of Second Crop of Crystals.

These crystals were washed and dried as the first crop, the total weight being about 10 or 12 grms. These operations were effected most rapidly, and the substance

replaced in the vacuum over sulphuric acid. During this drying, it lost much chlorine, which could be smelt in the receiver; thus when it had been under the air-pump for several days, and must have been practically dry, it lost in 20 hours 0·35 grm. by weight.

After four days it was rapidly powdered and subjected to the following examination. All weighings were effected at the same time:—

A little was dissolved in water (mere opalescence) and carbonic anhydride was passed through the solution, when a chlorinated body was evolved, and a vast precipitate of $CaCO_3$ formed. When this was done hot, chlorate was undoubtedly formed in the solution as indicated by the ordinary tests for chlorates. All the chlorine could not be expelled by carbonic anhydride in the cold. This reaction is characteristic of hypochlorites.

Calcium and chlorine were determined by solution in water, and destruction of hypochlorite by ammonia (Kolbe's method) in the hot solution. Then calcium was precipitated as oxalate (and determined as CaO), whilst chlorine was estimated in the filtrate.

Water was estimated by heating in a platinum boat, contained in a tube filled with lead chromate, and fitted with a sulphuric acid tube as in an organic analysis. This afforded an easy and effective method, not a trace of chlorine in any form passing over into the sulphuric acid tube.

0·503 grm. gave 0·1778 grm. CaO = 25·24 per cent Ca, and 0·7412 grm. AgCl = to 36·45 per cent Cl.

0·3986 grm. gave 0·0724 grm. water = 18·16 per cent H_2O.

Thus we get—

	Per cent.	÷ at wgts.	÷ Ca = 1.
Ca	= 25·24	0·631	1·00
Cl	= 36·45	1·026	1·62
O	= 20·05	1·253	1·98
H_2O	= 18·16	1·008	1·59

This may be regarded as a molecule of calcic hypochlorite in which nearly 0·5 atom of chlorine has been lost, for from beginning to end of the experiment oxygen (as air) was carefully excluded, and here the relation of calcium to oxygen is that which exists in hypochlorite.

Four days after this analysis had been made, the active chlorine was determined by Bunsen's method: 0·4454 grm. was dissolved in 200 c.c. water.

a. 20 c.c. diluted to 100 c.c., KI and HCl added, &c., took	8·6 c.c.	$Na_2S_2O_3$
b. 20 c.c. diluted to 100 c.c., KI and HCl added, &c., took	8·7	,,
Mean =	8·65	,,

1 c.c. $Na_2S_2O_3$ = 0·01224 iodine, therefore by reaction $CaCl_2O_2 + 4HCl = 2H_2O + CaCl_2 + 2Cl_2$ = to 33·21 per cent Cl.

The difference between 36·45 per cent Cl in previous analysis by this ammonia method, and 33·21 per cent Cl by Bunsen's method, I am inclined to regard as loss during the interval above alluded to, rather than as a proof of the presence of any chloride. But even if this difference proved chloride to be present and indicated an equivalent amount of chlorate, that must have arisen from an internal decomposition under the air-pump, and then the bulk of the body must be regarded as hypochlorite.

Experiment 4.—This was an analysis of a distinct crop of freshly prepared crystals, which were not dried to the same extent as those in the foregoing analyses, although equally well washed. Calcium was determined by the fusion process (as $CaSO_4$), and so also the total chlorine, which was confirmed by ammonia method, whilst the active chlorine was estimated by Bunsen's method. Water was estimated as described above.

1·732 grm. gave 0·958 grm. $CaSO_4$ = 16·26 per cent Ca, and 1·693 AgCl = 24·17 per cent Cl.

In Bunsen's method, 1·133 grm. dissolved in 200 c.c. H_2O, 20 c.c. took in two experiments 15 c.c. $Na_2S_2O_3$ (1 c.c. $Na_2S_2O_3$ = 0·01224 I) = to 22·64 per cent Cl.

0·7666 grm. gave 0·3624 grm. water = to 47·27 per cent H_2O.

Now deducting 47·27 per cent water, and re-calculating per cents for the free body, we get—

	Per cent.	÷ at wgts.	÷ Ca = 1.
Ca =	30·83	0·77	1·0
Cl =	45·86	1·29	1·7
O =	23·31	1·45	2·0
	100·00		

Or we may calculate the chlorine as given by Bunsen's method to exist as $CaCl_2O_2$, and the excess of calcium to exist as CaO and $CaCl_2$. Thus—

$CaCl_2O_2$ =	45·59 per cent.		
Water =	47·27 ,,		
$CaCl_2$ =	2·37 ,,		
CaO =	3·71 ,,	or $CaCO_3$ =	6·62
	98·94 ,,		101·85 per cent.

Calculate it as we may, it evidently nearly pure hypochlorite, and this is confirmed by its properties, and above all things by the determination of chlorine by Kolbe's ammonia process, which would give only Cl as $CaCl_2O_2$ and $CaCl_2$. This determination was not effected till the next day, when 0·306 grm. gave 0·320 grm. AgCl = to 25·86 per cent, a result identical with the total chlorine in the previous analysis, or at least only in such slight excess as would be caused by the substance having become slightly drier during the interval between the respective analyses.

This body is so prone to decompose in certain phases of its existence, that it might be expected to be admixed with chlorate at times, and this indeed seemed to be the case in one analysis, where it had reference to a product which had been dried under circumstances which involved hammering, but moreover it was the *crust* from the solution which on further evaporation yielded crystals whose analysis has been last given.

Ca and Cl determined only by the ammonia process, and water as already described, gave—

		÷ at wgts.	÷ Ca = 1.	
Ca =	20·45	0·511	1·00	
Cl =	29·19	0·822	1·60	× 5 $\left\{\begin{matrix}\overline{Ca_5Cl_{10}O_{14}} \\ 4CaCl_2O_2 \\ +CaCl_2O_6 \\ \overline{Ca_5Cl_{10}O_{14}}\end{matrix}\right.$
O =	23·59	1·469	2·87	
H_2O =	26·77	1·480	2·89	
	100·00			

Unfortunately in this analysis the total and active chlorine were not respectively estimated.

Finally, I may add that although the foregoing may be regarded as perfect proof of the body being in mass, hypochlorite of calcium (and to my mind this conclusion is inevitable), yet nevertheless, one cannot be too careful in concluding on evidence which is at all doubtful. I therefore consider that it is highly desirable that these experiments should be repeated on many samples of bleaching-powder, special care being devoted to the determination of the form in which the chlorine is attached. I can only regret that I am unable to undertake this work, at the present time.

Additional Notes.

In the first place I wish to point out that in what has gone before, the identity of those crystals obtained by freezing a strong solution of bleaching-powder, with those obtained by evaporation over sulphuric acid *in vacuo*, has not been established by analysis.

But I especially wish to direct attention here, to the possible application of the knowledge obtained through the experiments described, to industry.

The use of bleaching-powder was patented in 1799 by Mr. Tennant, and it soon superseded the use of "Lye of Javelle," and also of *solution* of chloride of lime.

The advantages "bleaching-powder" possesses over its solution, are obvious, and it is needless to specify them, but if pure hypochlorite of calcium could be made commercially, it would supersede the manufacture of bleaching-powder, seeing that (*a*) it is entirely and easily soluble in water, and (*b*) it possesses the total bleaching effect of "bleaching-powder" in much less volume.

And here I must state that what follows I wish to be regarded rather as suggestions than propositions.

The "bleach liquor" could be prepared from dilute chlorine, that is, from such chlorine as is manufactured by Deacon's process, or (in part) by Weldon's "manganite of magnesium" process. This would be effected in the way suggested by Mr. Weldon, which is carried out by introducing the gas into towers lined with lead, where it meets a shower of "milk of lime," and reacts on it to form "bleach liquor" $\overbrace{CaCl_2O_2 + CaCl_2}$. Care would have to be taken not to employ an excess of chlorine, as is done by Mr. Weldon, for if this were done, hypochlorous acid and chloride of calcium only would result. But the absorption of chlorine would be limited to the production of "bleach liquor." Now comes the great difficulty, viz., how to concentrate that liquor so as to crystallise out, or otherwise separate, the hypochlorite of calcium it contains.

Heat cannot be employed, as it causes the decomposition of the hypochlorite.

It was thought that freezing might perhaps be resorted to, but beyond the difficulty that would attend such an operation on a large scale, the few experiments I made in that direction went to show that the hypochlorite froze with the ice, that is it solidified in combination with the water. If in any way it could be concentrated over lime, that lime could be used for making the "milk of lime" in a new operation, and so no chlorine would be lost.

But how this is possible, or whether a vacuum pan of any specific construction could be employed, are questions which I cannot answer, although they are questions well worthy of consideration, by men who are used to encountering such difficulties.

ON MELLILOTOL.

By Dr. T. L. PHIPSON.

MELLILOTOL is an acid oil slightly soluble in water, soluble in alcohol and ether, transformed into mellilotic acid (of Zwenger) by the action of potassa and in other circumstances. It is endowed with a most fragrant odour, which is that of new mown hay. I have obtained it by distilling *Mellilotus officinalis* with water and isolating it from the distillate by means of ether. The plant was gathered while in full bloom; that which grows in sheltered places on our southern coasts, and is in flower in August is rather rich in this product. About 0·2 per cent of pure mellilotol was obtained from the dried plant by distilling the stalks, leaves, and flowers together.

Mellilotol is the starting-point of a great variety of very interesting compounds; it yields, as before stated, mellilotic acid, which in its turn yields coumarin. *Mellilotol, and not coumarin, is the cause of the odour of the hayfields, and of the flowers of the mellilotus.* It is difficult to separate it entirely from mellilotic acid in the preparation of the latter; by boiling with concentrated potash it is transformed into mellilotic acid, whilst a slight odour of oil of bitter almonds is developed. The composition of mellilotol appears to be $C_{18}H_8O_4$, that of coumarin being $C_{18}H_6O_4$. It was in endeavouring to ascertain how much coumarin could be obtained from *mellilotus* growing at Weymouth, and extremely fragrant, that I discovered this mellilotol, and I suppose it to be the oil which accompanied the mellilotic acid obtained by Zwenger.

London, July 11, 1875.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from page 11).

SINCE 1867 Tessié du Motay has attempted to apply the oxygen light to streets and squares. The places before the Tuileries and before the Hôtel de Ville were radiant with the light thrown off by cylinders of zircon† under the joint influence of coal-gas and oxygen. The fluctuating nature of the flame and the great expense induced him to turn his attention to the carburation of hydrogen and coal-gas. These gases were led before entering the burners into a vessel attached to each lamp, and containing heavy hydrocarbons. In this manner the Boulevards between Rue Drouot and Rue Scribe were illuminated with 70 oxygen burners. This method, also, was given up, and a highly carburetted gas was prepared in place of common coal-gas, and was burnt along with oxygen. In this new modification the process was seen by visitors to the Vienna Exhibition at the Empress Elizabeth Western Railway Terminus. From a manuscript report which Herr Karl Haase, manager of the 4th Berlin gas-works, handed in to the directors of the municipal committee on lighting, we borrow the following graphic description.

"The sight of the plantations of the Elizabeth Station, and of its various compartments lit up with coal-gas and oxygen, is quite surprising. The effect of the light given off by the small bluish flames of the lamps is quite peculiar, and cannot be paralleled by any other system of lighting. The green of the trees and shrubs appears more lively, the colour of costumes more brilliant, and above all the faces of persons seem more distinct. Every shade of colour and every configuration comes out almost as distinctly as in full day-light, and yet the eye is not wearied. This favourable impression received in the plantations is still heightened on entering the large second class waiting room. Here every object, and even the most trifling details of the decorations, are shown most distinctly by the small flames of two moderate-sized gaseliers.

"The strongest impression as regards the efficacy of this new system of illumination is experienced on entering the departure-platform. Here, in order to make the difference more striking, the stairs used by the departing passengers were lit up with heavy gas aided by oxygen, but only half as many lamps were kindled as on the opposite stairs, where the old gas was burning along with oxygen. In spite of the double number of the burners and the good quality of the coal-gas (equal 24 candles) the space lighted on the new system appeared far more brilliant."

In spite of this favourable impression, however, Haase declares the new double gas, which is conveyed in two sets of pipes, unsuitable for general private consumption. He gives, amongst others, the following reasons for his opinion. The advantage of brightness is more than compensated by the price, which in Berlin, calculated for the same degree of brightness would amount to double the price of common gas.

The consumer will not be able to manage accurately

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† Burnt zirconia kneaded into a paste with aqueous boracic acid, and burnt in iron moulds at a red heat.

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the changing regulation of the cocks. The oxygen will become impoverished by passing through long distances of mains, and the repairs of the double system will be considerable, &c. For certain public establishments, for millinery warehouses, and certain other purposes the new process will be well adapted. But it would be out of the question to keep up a triple system of mains for the sake of such limited applications. This opinion is in flat contradiction to that of Schiele;* but it agrees closely with the report which le Blanc† a year earlier had presented to the municipal gas direction of Paris.

(To be continued.)

SOCIETY OF PUBLIC ANALYSTS.

In another column we publish a letter from Dr. Dupré on the subject of Milk Adulteration. We also reprint a report of certain proceedings in the Greenwich Police Court, and an extract from the parliamentary proceedings, reported in the *Times* of the 14th inst.

The subject is so important that we reprint the analyses of Dr. Voelcker referred to in Dr. Dupré's letter.

In 1863 Dr. Voelcker published a pamphlet on Milk, in which he gives the following table as the results of twenty-two analyses. The last column is added by us. It is, of course, simply the result obtained by adding together the casein, sugar, and ash:—

COMPOSITION OF MORNING'S AND EVENING'S MILK PRODUCED ON THE ROYAL AGRICULTURAL COLLEGE FARM, CIRENCESTER.

		Percentage of					
		Water.	Butter Pure Fat.	Casein and Albumen.	Milk Sugar.	Ash.	Solids not Fat.
Jan.,	Morning..	87·70	2·60	2·94	5·82	0·94	9·70
,,	Evening..	87·40	2·28	2·87	6·56	0·89	10·34
Feb.,	Morning..	87·50	2·58	3·44	5·44	1·04	9·92
,,	Evening..	86·40	3·53	3·37	5·56	1·14	10·07
March,	Morning	88·60	2·71	2·43	5·35	0·91	8·69
,,	Evening..	88·16	2·96	2·62	5·55	0·77	8·88
April,	Morning..	87·50	3·15	2·94	5·60	0·81	9·35
,,	Evening..	89·00	2·47	2·69	5·08	0·76	8·53
May,	Morning..	88·20	2·42	3·12	5·49	0·77	9·38
,,	Evening..	87·80	2·71	2·87	5·85	0·77	9·49
June,	Morning..	87·30	3·05	3·00	5·89	0·76	9·65
,,	Evening..	87·30	2·94	2·87	6·05	0·84	9·76
July,	Morning..	88·70	2·22	2·94	5·38	0·76	9·98
,,	Evening..	87·80	3·61	2·81	5·10	0·68	8·56
Sept.,	Morning..	89·91	1·99	2·94	4·48	0·64	8·10
,,	Evening..	90·70	1·79	2·81	4·04	0·66	7·51
Oct.,	Morning..	87·60	3·90	2·87	4·84	0·79	8·50
,,	Evening..	90·30	2·99	2·37	3·76	0·58	6·71
Nov.,	Morning..	87·10	3·41	2·94	5·41	1·14	9·49
,,	Evening..	86·20	3·78	3·19	5·68	1·15	10·02
Dec.,	Morning..	86·70	3·74	2·87	5·92	0·77	9·56
,,	Evening..	86·00	4·12	3·62	5·46	0·80	9·88

The average of the whole of solids not fat is 9·18 per cent. Dr. Voelcker remarks in reference to these analyses, the milk cows were out in grass from May till the end of October, but as the herbage then became so scarce as not to afford sufficient nourishment, they were fed in the evening, in the stalls, with roots and hay, &c. It will be seen that both the morning's and evening's milk in September was extremely poor. The cows were then out in grass, but the pasture was poor and overstocked, so that the daily growth of grass furnished hardly enough food to meet the daily waste to which the animal frame is subject, and was thus not calculated to meet an extra demand of materials for the formation of curd and butter.

The poverty of this milk thus was evidently due to an insufficient supply of food.

In the same pamphlet he gives the results of the analyses of four samples of milk from two other farms on which the cows were out in grass, having an abundant supply of grass of good average quality; the solids not fat of which were 9·49, 9·04, 9·40, 8·71.

In subsequent pages in his pamphlet Dr. Voelcker gives 14 other analyses in which the solids not fat are as follows:—9·17, 9·84, 9·49, 9·04, 9·40, 8·71, 9·36, 8·94, 8·62, 9·22, 9·14, 9·31, 9·49, 9·29, the average of the whole being 9·21 per cent.

Last year Dr. Voelcker gave a lecture before the Farmer's Club, in which he repeated the table of figures given in 1863, apparently without any additional facts.

In most of these cases we are left to assume that the milk was perfectly genuine. It seems obvious, however, that in order to assume this fairly the cows should have been milked dry in the presence of the analyst himself or of equally trustworthy witnesses.

* *Schiele, Journal f. Gasbeleuchtung*, Jan., 1873.

† "Rapport de M. F. le Blanc sur le nouvel éclairage oxyhydrique. Paris, 1872; also *Journal f. Gasbeleuchtung*, 1872, 641.

PUBLIC ANALYSTS.

To the Editor of the Chemical News.

SIR,—It seems to me high time that our London magistrates should awake to the magnitude of the evil involved in milk adulteration. The fines usually inflicted are ludicrously inadequate to suppress the evil; and it is sufficient to make one's blood boil with indignation to see, in the same paper, a report of a poor, and presumably respectable and virtuous, girl being sentenced to fourteen days' imprisonment and four years in a reformatory for plucking a flower, and a number of milk adulterators fined from 2s. 6d. to 5s. for having added, say, from 15 to 20 per cent of water to their milk, to say nothing of those let off because, forsooth, they had added *only* 10 per cent. Now, a fine of 5s. simply means the sale of 12 quarts of water, which would be contained in 72 quarts, or 9 gallons, of milk and water, supposing 20 per cent of water to be added to the pure milk.

There are wholesale milk dealers in London to whom an addition of *only* 10 per cent of water to the milk they sell would yield a yearly profit of *only* from £1000 to £2000. And such an evil it is attempted to check by 2s. 6d. and 5s. fines!

I do not know the amount of milk consumed in London, but the daily consumption cannot be less, and is probably more, than 200,000 quarts. An addition of *only* 10 per cent means, therefore, something like 20,000 quarts of water sold daily as milk, which, at 5d. per quart, gives *only* £417 per diem, or a yearly trifle of *only* £152,000, no small proportion of the total London water-rate.

I trust, therefore, that in the interest of the public, but particularly in that of the poorer classes and of children, a thorough discussion of the milk question may take place in your columns so as to bring the magnitude of the evil still to be contended against home to all, including magistrates.

I am happy to be able to say that the quality of the milk supplied in my district has very greatly improved since the passing of the Adulteration Act, but I have no doubt that the improvement would have been greater still if the fines inflicted had been heavier.

A discussion such as I suggest would also, I think, finally dispose of Professor Voelcker's milk analyses, made avowedly on starving cows, at a time when milk analysis was certainly much less understood than it is now, and by means of methods of which we know nothing. As his pamphlet has already done much harm, and will, no doubt, do much more, I would call upon Professor Voelcker to publish the exact methods by means of which his results have been obtained.—I am, &c.,

A. DUPRÉ.

Westminster Hospital,
July 10, 1875.

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ADULTERATED MILK.

IN the House of Commons on July 13, "Dr. Cameron asked the Home Secretary whether his attention had been called to a report in the *Times* of July 3, from which it appeared that Mr. Balguy, the presiding magistrate at Greenwich Police Court, had publicly announced that, after consultation with his brother magistrates, he had resolved not to impose fines in cases of the adulteration of milk with water when such adulteration was not over 10 per cent, and whether the adulteration acts now in force warrant magistrates in allowing the adulteration of milk with water, if not practised to a greater extent than 10 per cent, to pass unpunished?"

"Mr. CROSS—Yes, it is substantially true that the magistrate did say so after having consulted with some of his brother magistrates; but I cannot think that is a view of the law which will be acquiesced in by my right hon. friend the President of Local Government Board, either under the act now in force, or under the bill now passing through the House."—*Times*, July 14, 1875.

Two summonses against persons for selling milk adulterated with 10 per cent of water came before Mr. Balguy for determination, with the like result of another similar percentage a fortnight since. The cases having been proved, Mr. Balguy intimated that he had recently, in similar cases of only 10 per cent certified as that of water adulterated with milk, decided upon not convicting, but dismissing the summonses on payment of costs.—Mr. Farnfield said that he understood the quality of the milk was analysed from the standard of the very poorest milk.—Mr. Balguy said the question had been raised in that court and elsewhere as to the differences that occurred in the water in milk where the animals were fed on the same kind of food, and it was the opinion of scientific men, among whom were Professor Voelcker, that these differences existed so far as 10 per cent was concerned. He had consulted other magistrates upon the point, and they had agreed with him, but in flagrant cases there would be no hesitation in conviction. He would admit that he had imposed penalties in cases of 10 per cent adulteration being given in certificates, and he wished afterwards he had not done so. In dealing thus with these cases, he held that the District Boards were only performing the duties required of them in taking proceedings, and no offence was implied in dismissing the summonses on payment of the costs. This course was agreed to in both cases."—*Kentish Mercury*, July 10, 1875.

NOTICES OF BOOKS.

Annual Record of Science and Industry for 1874. Edited by SPENCER F. BAIRD. London: Trübner and Co.

THE rapid progress of discovery and invention, and the vast extent of the periodical, scientific, and technological literature of our day combine to render a work like the one before us absolutely indispensable. We have on a former occasion declared Mr. Baird's Annual Record to be the best compilation of the kind accessible to the English reader, and we see no reason for altering our opinion, Great care and judgment have been displayed in the selection of the matter, and of the sources whence it is taken. We do not find (as in some annual publications of this nature) paragraphs from ordinary newspapers placed on the same level with extracts from scientific journals and from the transactions of learned societies. Here and there we observe, it is true, sins against methodology in the classification of the matter, and one paragraph is twice repeated. But when we consider the difficulty of collecting and arranging such a mass of facts, we can only wonder that these oversights are not more frequent.

There is, of course, one drawback to which all works of this kind must be liable. Much of the information is necessarily not very recent. But we must remember that the object aimed at is not to furnish the latest novelties, but to give in a compact and handy form a general oversight of the world's scientific work for the past year. One suggestion we would beg to make—as the book is published in London with a view to a circulation in Britain, we think the ordinary English orthography should have been followed.

The value of the book is enhanced by a copious index, an obituary notice of men of science who have died during the past year, and a list of the scientific works published during the same period, which, however, is by no means complete.

On the Composition of the Ground Atmosphere, with some Examinations of the Air in Smoking Cars. By Professor W. R. NICHOLS. Boston: Wright and Potter.

THE experiments on the composition of the air pervading soils and rocks, instituted by Professor Pettenkofer, have excited a very widespread attention, and in various localities chemists are engaged with similar investigations. Professor Nichols, at the request of the Local Board of Health, has been analysing the air below the surface of the soil in the so-called "Back-Bay lands" of Boston. A part of the city stands on made ground, the mud of the Back Bay having been covered over with gravel. Air obtained from the soil at various depths was found free from sulphuretted hydrogen, and the amount of ammonia was 0·00004 grm. to 5 litres of air. But the carbonic acid was in excess over that found in the atmosphere above the surface; the quantity being in one case 4·77 parts in 1000.

The investigation of the atmosphere of smoking-carriages in railway trains has not led to any decisive results. The author did not succeed in detecting either the fatty acids or any of the alkaloid bodies. The amount of ammonia in the air of smoking-carriages was found decidedly greater than in that of ordinary carriages; but the proportion of carbonic acid, on the other hand, was somewhat smaller.

We must confess that we attach no very high value to these results. Railway carriages differ in their cubic contents, and very greatly in their ventilating arrangements. It would be necessary to get two carriages exactly alike in size and construction, and containing each the same number of passengers—smokers in the one case and non-smokers in the other—before a safe basis for analysis could be obtained. The difference between the atmosphere of a smoking-carriage and of an ordinary carriage depends, doubtless, as the author observes, on substances too minute in quantity to admit of determination.

CORRESPONDENCE.

MELTING-POINTS OF FATS.

To the Editor of the Chemical News.

SIR,—From the papers which have recently appeared in the CHEMICAL NEWS (vol. xxxi., pp. 205, 226, 227) "On an Easy Method of Taking the Melting-Points of Butter and Other Fats;" "A Method of Determining the Fusing-Points of Fats;" and "On a Method of Taking the Melting Points of Fats;" it appears that certain characteristic phenomena of the fusion of these substances have escaped the observation of the authors of these papers, and that certain apparent anomalies have in consequence been ascribed to causes other than the real ones.

In a paper which appeared in the *Journ. Chem. Soc.*, vol. v., p. 197, and also in the *Comptes Rendus de l'Academie*, I formerly pointed out these phenomena as seen in the fusion of comparatively pure glycerides, and showed that

they depend upon the property of these substances to assume under the influence of heat different modifications, which, for reasons that need not be here entered upon, I called *isomeric*, but which will be better understood now if designated *allotropic*.

In the course of an enquiry by which it was proposed to ascertain how far this property attaches to glycerides when mixed, as in the natural fats, and if it attach to them whether it exercises any important function in the economy of living animals and plants, I have made some observations on butter, pork-fat, and mutton-fat, in their natural state—separation of the caseine and tissue being understood—the results of which may be of interest at present.

Each of these substances is capable of assuming at least two allotropic modifications. There is also a third condition of each; but whether this is a specific modification, or only a mixture of the other two modifications, cannot be affirmed at present. It is, however, a remarkable fact that the temperature at which a fat in this condition melts has been universally accepted as *the* melting-point of the fat. For the purpose of identifying it relatively to the other melting-points, I will speak of this one as the second melting-point, and of the other two as the first and third respectively in the order of the temperatures at which they occur; the several modifications of the fat being also designated first, second, and third, according as they melt at the first, second, or third of these points.

If a specimen of butter, the second melting-point of which lies at 31·2° C., be heated to 60°, and then solidified by powerful exposure to a temperature not exceeding 14° or 15°, it will melt at 17°. This melting is most readily made visible by plunging a capillary tube containing a portion of the substance into water at that temperature. If the substance be now kept within the range of temperature from 17° to 20°, it solidifies, and in doing so passes more or less completely into an allotropic modification, the second, which melts only when the temperature rises to 31°-2°. If the liquid formed by fusion at this point be kept for some hours at a temperature not varying more than 2° or 3° on either side of 31°-2° it becomes opaque, a great part of it solidifying as crystals, the third modification, which retain their opacity till the temperature rises to 40°, or upwards, according to the length of time at which the substance has been kept at a temperature about 31°-2°. I have reason to regard the crystals formed in this manner as identical with those deposited in an ethereal solution of butter, which melt at 53°-7° according to their state of purification.

After being heated to upwards of 60°, and solidified by cooling below 20°, pork-fat melted at 27°-8°; passing into the second modification it melted again at 37°-8°. Long continued heating near this temperature converts so small a proportion of this substance into the third modification that any consequent elevation of the melting-point of the mass cannot be determined with precision.

Mutton-fat, after exposure to a temperature presumed to be higher than any of its melting-points, and subsequent solidification at a temperature presumably below all of them, melted at 39°, solidifying again while the temperature rose slowly to 52°-3°, where it melted a second time, and when kept for some hours within a range of temperatures not exceeding 3° on either side of this second melting-point, solidified again, and then melted only when the temperature rose to 57°. It thus solidified only when the temperature fell below all three melting-points, unless the cooling were much retarded. In all cases the temperature at which solidification takes place determines the *modification*, and consequently the melting-point of the substance.

The glycerine fats as occurring in nature consist of a mixture, the constituents of which are not all equally susceptible of allotropic modification; the phenomena of their allotropy are consequently more complicated than those of any one of their constituents; but anomalies such as an alteration of their melting-point by the action of drying or by shaking *per se* which Dr. Tripe and Mr. Heisch met with, have not come within my observation.

I infer from Mr. Heisch's paper, and from Dr. Redwood's reference to my experiments reported in CHEMICAL NEWS, vol. xxxi., p. 257, that when Mr. Heisch read his paper, he had not seen a full account of the methods which I employed for determining the melting-points of fats and the fluidity of melted fats. If he had he would have found that I had used tubes such as he recommends; but that, under circumstances, and for reasons, which I specified, I gave a preference to tubes in which the fats were protected from contact with the surrounding water.—I am, &c.,

PATR. DUFFY.

Anglesea Road, Ipswich,
June 28, 1875.

SOLIDS IN MILK.

To the Editor of the Chemical News.

SIR,—My object in writing a note on the minimum of solids in milk was not to controvert any of Mr. Wanklyn's statements; if such had been my object, I should have first remarked that Mr. Wanklyn takes as his standard 9·3 per cent of "solids not fat," and then quoted the following examples:—

	Total Solids.	Fat.	Solids not Fat.
No. 4. Average sample from several well-fed cows on a rich farm in Cheshire; March	12·90	4·40	8·50
No. 5. Country milk; February ..	12·35	3·74	8·61
No. 6. Cheshire milk, stall fed; January	12·46	4·00	8·46

Anyone who accepted Mr. Wanklyn's generalisations as rules, would declare that these samples were adulterated with 8 or 10 per cent. of water; whereas they were unusually rich samples from uncommonly well-fed cows. My object in writing to the Society of Public Analysts was to show (to those who think it better that some who add a small quantity of water to rich milk should go unpunished, than that one innocent person should be unjustly fined), that the limit accepted by the Council of the Society "must be used with great caution in instituting proceedings," when the deficiency below that limit is small. The Council's limit is thus expressed: "*Milk* shall contain not less than 9·0 per cent, by weight, of milk solids not fat, and not less than 2·5 per cent of butter fat." These make a total of 11·5 "solids not fat." I quoted three cases which were deficient either in fat or other solids, or in both; and since the note was written, some months ago, I have met with the following instructive cases of pure milk, fairly taken:—

	Total Solids.	Fat.	Solids not Fat.
No. 7.	11·00	2·70	8·30
No. 8. Old cow, badly fed; yielded only 3 pints	11·00	2·14	8·86
No. 9. Half-starved middle aged cow; yielded 2 quarts..	10·48	2·31	8·17
No. 10. Average of several half-starved cows	11·10	2·33	8·77

The following authentic cases have total solids below my minimum of 11·0, and the fat below the Council's minimum of 2·5; but escape if we take the standard of 9·0 solids without limiting the fat:—

	Total Solids.	Fat.	Solids not Fat.
No. 11. ..	10·27	1·29	8·98
No. 12. ..	10·67	1·09	9·58

Thus it appears that it is not safe to assert, on analytical grounds alone, without corroborative proof, that a sample of milk is adulterated with water, unless it contains below 11·0 per cent of total solids as well as below 9·0

per cent of solids not fat; nor even then, if it contains so much as 2·7 per cent of fat.—I am, &c.,

J. Campbell Brown.

Royal Infirmary School of Medicine,
Liverpool, June 29, 1875.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—The recent correspondence upon mineralogical nomenclature and doubtful minerals, which has come before the readers of the Chemical News, shows very plainly the great need there is of a *Mineralogical Society*. Mineralogy is no longer a mere branch of geology, and it cannot expect to receive a proper amount of that kind of support and advancement which results from scientific association, while its students are content to be swamped in the Geological Society by the enormous preponderance of palæontological geologists.

A *Mineralogical Society of England* might fitly grapple with the questions lately brought before your readers; but those who know what the fortnightly meetings of the Geological Society are, would have little expectation of any good result from a discussion of such details at those meetings.

If Messrs. Maskelyne, Smyth, Forbes, and a few others, would only agree together to promote the formation of such a society, I feel sure that they would be at once joined by a large number of English mineralogists of lesser note, that the long lists of "doubtful minerals" would be speedily reduced, and that mineralogical nomenclature would soon be placed upon a more reasonable basis.

With reference to the Appendix B of T. A. R.'s letter in the Chemical News of last week, permit me to inform him that the *soda tungstate* from E. Pool Mine is a *chemical product*, and not a mineral.—I am, &c.,

J. H. Collins.

Truro, July 12, 1875.

ACTION OF THE GALVANIC CURRENT ON THE ORGANS OF SENSATION.

To the Editor of the Chemical News.

Sir,—In the report of the proceedings of the Physical Society contained in your valuable paper (Chemical News, vol. xxxi., p. 13), I read an account of Dr. Stone's communication "On Subjective Sensations of Taste," in which, after satisfying himself that no zinc is dissolved by the saliva in the production of the "galvanic taste," the author states that, "it could hardly be referred to chemical action, but must result from direct stimulation of the sensatory apparatus," &c. I beg to refer that gentleman to my paper in the *Comptes Rendus* of the Paris Academy for Nov. 9, 1874, p. 1072, entitled "Action du courant électrique sur les organes des Sens," in which he will find that his conclusions have been anticipated.—I am, &c.,

T. L. Phipson, Ph.D.

London, July 11, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, tome lxxx., No. 24, June 21, 1875.

This issue contains no papers, being filled up with notices of the different prizes awarded by the Academy of Sciences.

Bulletin de la Societe Chimique de Paris, No. 11, June 5, 1875.

Action of Water upon Uric Acid.—M. L. Magnier de la Source.—In seeking to determine the coefficient of solubility of uric acid, both in pure water and in water acidulated with uric acid, the author has observed certain facts which seem to indicate the dissociation of uric acid in very dilute solutions. He draws the following conclusions from his experiments:—That uric acid in very dilute solutions has a variable coefficient of solubility, the higher the more dilute the solution. This increase of the coefficient of solubility appears due, at first, to the production of a more soluble hydrate, and ultimately to the dissociation of that hydrate into urea and dialuric acid, easily characterised by the insolubility of its potash-salt and the property which it possesses of becoming transformed into an iso-alloxanate. This dissociation is considerably accelerated under the influence of heat, particularly in presence of potash. These operations must be carried on in the absence of air.

New Body found in Urine after the Ingestion of Chloral Hydrate.—MM. Musculus and De Mering.—The composition of this body is—

Carbon	31·94
Hydrogen	4·56
Chlorine	26·99
Oxygen	36·50

Unequal Solubility of the Different Faces of the Same Crystal, and on the Relation existing between this Property and certain General Principles of the Natural Sciences.—M. L. Pfaundler.—The author's views may be summed up as follows:—Building upon the theory of Clausius as to the state of aggregation, he admits that liquid molecules are in a state of unequal movement. Some of them possess a greater *vis viva* (temperature), and others a less. What we call the temperature of the liquid is merely the mean temperature of the totality of the molecules. The molecules of a crystal are also in motion around certain positions of equilibrium; their state of motion (that is to say, their temperature) varies within certain limits. It is not equal at all points and in all directions. When this difference rises beyond a certain limit, the molecule is torn away and becomes liquid. Liquid molecules clash, in their movements of translation, against the crystalline molecules. From these shocks may result three consequences—either there is simple reflection of the impinging molecule, or adherence, or displacement of the molecule struck. The author has shown in detail.* The crystal does not change in weight, provided that in the same time as many molecules are removed as remain adhering on the other hand. The state of equilibrium of a crystal in its saturated solution is, therefore, not a static, but a dynamic equilibrium. Its weight remains constant, not because there is neither solution nor crystallisation, but because the two phenomena mutually compensate each other. The crystal begins to dissolve when circumstances become favourable to produce impacts which determine the separation of solid molecules (*e.g.*, when the temperature, or, in other words, the *vis viva*, of the molecules increases), or when the impacts which occasion the adherence of molecules become more rare (*e.g.*, when the solution is diluted). Reduction of temperature and concentration disturb the equilibrium in the opposite direction, and the crystal increases. If the mean vibratory condition is the same on the surface of the crystal at all points and in all directions, there will be, on the average, at every part of the crystal, as many conditions favourable to the fixation as to the removal of molecules, and consequently the crystal will not change its form. If this condition is not fulfilled, the conditions favourable to fixation may have the advantage in certain places, and those favourable to displacement in others. This explains the growth of certain parts at the expense of others, and consequently the successive transportation of material molecules by the solution, without

* *Sitzungsberichte der K. Academie der Wiss. in Wien*, lix.

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the latter requiring to be supersaturated, even temporarily, or to change in temperature. The faces of the crystal, which possess conditions favourable to resistance, as regards the impinging molecules, preserve themselves and repair themselves at the expense of the others. M. Lecoq de Boisbaudran has extended his view even to the gaseous state. The author has done the same in the memoir above cited, and has, for instance, explained how iodine in powder surrounded with vapour may, without change of temperature, change into larger crystals. The same interpretation may be given for the slow crystallisation of solid amorphous bodies. These phenomena, and others also, may be regarded from a much more general point of view. This the author has sought to develop in his treatise, entitled "The Vital Competition (Concurrence) between Molecules: a New Contribution to Chemical Statics."* He has shown, among other things, that the principles of Darwin are applicable also in the molecular sphere. The forms and the combinations which possess conditions most favourable to existence are those which maintain themselves. If the conditions change, the forms and the combinations change also; consequently, the combinations formed by the strongest affinities are, by preference, preserved. But in this case, also, the right of the strongest does not always prevail. As there are in the animal kingdom forms which are preserved because they know how to escape or to hide themselves, so in chemical reactions, in spite of energetic affinities, compounds are maintained because by their volatility they are withdrawn from inverse reactions, or because by entrenching themselves in the crystalline form they are removed from the impulse of impinging molecules. Thus the views of the great Berthollet, on the influence of volatility (elasticity) and of insolubility (cohesion) on the progress of chemical phenomena, are found complemented and sustained by the application of conceptions by which Clausius and Darwin have enriched natural science in regions apparently widely remote from each other.

Researches on the Selenites.—M. F. Nilson.—Already noticed.

Caustic Soda.—The firm of Grüneberg and Vorster, of Kalk, near Cologne, have patented, in England, a process for obtaining caustic soda by passing superheated steam over a heated mixture of common salt and of alumina, or its hydrate.

Copying Pencils.—M. Ch. Viedt.—Pencils which give traces capable of being copied like those of copying inks are made from graphite ground up in water to a fine paste, of finely-powdered kaolin, and of a highly concentrated solution of an aniline violet-blue soluble in water.

Analysis of Burnt Pyrites.—M. G. Lunge.—According to the analysis of M. Gibb, the pyrites of San Domingos, of Tharsis, and of Rio Tinto contain, on an average, 47 to 49 per cent of sulphur.

	Copper. Per cent.	Silver. Ozs. per ton.
Rio Tinto..	3·80	1·20
Tharsis	3·50	0·75
San Domingos..	3·70	0·75

The burnt ores, as delivered by the sulphuric acid makers to the copper-works, have the following composition:—

	Rio Tinto.	Tharsis.	San Domingo.	Ytteroen, Norway.
Copper | Calculated as | Iron | $Cu_2Fe_2S_4$	1·6500 / 3·6400	1·5000 / 3·2300	1·5500 / 3·7600	1·01 / 3·33
Sulphur	3·5300	3·1500	3·6200	3·10
Oxide of copper	2·7500	2·5600	2·7000	0·39
„ zinc	2·0200	0·5500	0·4700	6·46
„ lead	0·4700	0·7000	0·8400	0·06
Silver	0·0037	0·0023	0·0023	—
Oxide of cobalt	0·0070	0·0320	0·0330	—
„ bismuth ..	0·0130	0·0100	0·0130	—
Lime	0·2000	0·2500	0·2800	2·30
Oxide of iron..	77·4000	77·0000	78·1500	68·06
Sulphuric acid (SO_3)..	6·1000	5·2500	5·8000	6·56
Arsenic acid	0·2400	0·1700	0·2500	0·05
Insoluble remnant ..	1·4500	5·8500	1·8500	8·74
	99·4700	100·2600	99·3200	100·06

* *Poggendorff's Jubelband*, p. 182; and *Pogg. Annalen*, cxxxi., p. 55.

On Certain Mordants Used for Dyeing Cotton.—M. Ch. Girard.—The mordants most generally used for dyeing cotton aniline blue are as follows:—For diphenylamin blues, the sulpho-conjugated salt of the blue being a calcic or barytic compound, it is sufficient to mordant the cotton in a solution of tannin at 3 per cent, and to pass directly into a solution of alum neutralised with carbonate of soda, then dye directly in the aqueous solution of the blue; brighten, wring and dry. For alkaline blues of which the sulpho-conjugated salts are generally sodic, or ammonic compounds, we take likewise an aqueous solution of tannin containing 3 per cent of the weight of the cotton; keep at a boil for a quarter of an hour, wring and dry. Then pass the cotton into a bath containing 1½ kilo. alum, 250 grms. tartar emetic, 750 grms. soda crystals, and 250 grms. tartaric acid. These ingredients are dissolved separately, and finally the colour is added. The bath is heated from 65° to 70°, the cotton is entered and worked while the temperature is allowed to sink. The bath serves continuously, more mordant being added as it becomes exhausted. Heavy shades are dyed first, then mediums, and then pale shades. To dye cotton with saffranin and night-green, the cotton is first passed into a solution of bichloride or oxymuriate of tin marking 2° (B.?), wrung, passed into a tannin bath, wrung, and then passed into the dye-beck. Cotton may also be mordanted in a solution of nitrate of urea (2 grms. per litre of water) at a boil; wrung, and passed into a solution of biphosphate of lime at 5 grms. per litre of water; wrung, and entered in the colour bath. In this manner almost all the aniline colours give very bright colours.

Action of Baryta upon Certain Mineral and Organic Compounds Contained in the Products of the Beet.—M. P. Lagrange.—The hydrate of baryta not merely removes all phosphoric acid from the juice of the beet, but acts also upon certain organic impurities, greatly improving the quality of the produce.

Lamp of Bisulphide of Carbon and Nitric Oxide.—MM. Delachanal and Mermet.—Taken from the *Comptes Rendus*.

On the Same Subject.—M. E. Sell.—From the *Berichte der Deutschen Chem. Gesell.*

On the Decomposition and Preservation of Wood.—M. Max. Paulet.—See *Comptes Rendus*, vol. lxxx., p. 23.

Les Mondes, Revue Hebdomadaire des Sciences, No. 6, June 10, 1875.

Process of Gilding.—Place in a plate leaf-gold, add a little honey, stir the two substances carefully together with a glass stopper, the lower end of which is very flat. Throw the resulting paste into a glass of water mixed with a little alcohol, wash it and leave it to settle. Decant the liquid and wash the deposit again. Repeat the same operation until the result is a fine, pure, and brilliant powder of gold. This powder, mixed with common salt and powdered cream of tartar, and stirred up in water, serves for gilding.

Another Method for Gilding.—Boutet de Mouvel.—Dissolve in *aqua regia* 1 grm. of fine gold, previously rolled out very thin, in a porcelain capsule heated on the sand-bath and concentrated till it is the colour of ox-blood. Add a half litre of distilled water, hot, in which have been dissolved 4 grms. of white cyanide of potassium. Stir with a glass rod, and filter the liquid through unsized paper. To gild with this liquid, it is heated a little above luke-warmness, and the articles to be gilt are immersed in it and supported upon a piece of very clean zinc.

Spectrum of Yttrium, Didymium, and Lanthanum.—R. Taleu.—Since in the two spectra these rays are very different in intensity, and since the most characteristic rays of the spectrum of a substance are wanting in that of another substance, we can explain these coincidences

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neither by the mutual impurities of the two bodies in question, nor by those of foreign bodies, of which the principal rays are known. The author is led to believe that these coincidences are quite apparent, and that, although the dispersion was produced by six prisms of flint, they depend solely on the fact that the dispersive power of the spectroscope was not sufficient for delicate determinations. The following examples show how near to each other the rays of different bodies may be :—

Di	4901·0 (2)	Di	4882·5 (2)
Y	4899·5 (1)	Y	4881·0 (1)
La	4899·0 (1)		

There is no reason why the difference in the wave-length of the neighbouring rays may not be still less than 0·5 of the unity selected, 0·0000001 m.m. The tables given will, in the opinion of the author, suffice to distinguish the metals in question perfectly from each other.

Transformation of Static Electricity into Dynamic Electricity.—M. R. Bichat.—Instead of producing sparks of static electricity by means of a Holtz machine, they may be produced by means of a second Ruhmkorff's coil. The thick wire of the second coil is connected with the extremities of the fine wire of the first.

Moniteur Scientifique du Dr. Quesneville, July, 1875.

On Fluoresceine and Phthaleine Orceine.—Emile Fischer.—A very valuable paper, but, from its great length, not suitable for insertion.

Analysis of Crude Anthracen.—G. E. Davis and T. H. Davis.—A translation from the English.

Lessons on the Manufacture of Beer, Regarded from a Chemical Point of View.—Dr. J. Graham.—A translation of the course of lectures delivered before the Society of Arts.

Analysis of Wines.—Dr. Macagno.—Already noticed.

Detection and Determination of Methylic Alcohol in presence of Vinic Alcohol.—Alfred Riche and Charles Bardy.—Already noticed.

The Phylloxera vastatrix.—A collection of extracts from official documents on the progress of the Phylloxera and the remedies proposed.

Action of Liquids, Alimentary or Medicinal, upon Tin Vessels and Glazes containing Lead.—M. Fordos.—Already noticed.

Prohibition of the Importation of Coal-tar Colours into Russia.—By a Ukase, dated February 25, the importation of aniline colours not crystallised, *i.e.* in paste, in fragments, or powder, is forbidden, as also the sale of similar products manufactured in Russia. Artificial alizarine is classed with non-crystallisable aniline colours.

MISCELLANEOUS.

Method of Obtaining a Constant Temperature.—Professor Cooke, of Harvard College, in experimenting on the vermiculites, wished to obtain a constant temperature of 100° C. For this purpose he employed an electric regulator of very simple construction. The current is made or broken by a very slight rise or fall of mercury in a U-tube connected with a glass bulb within the air-bath. By means of a pressure-tap which closes an open L of the connecting tube, the air within the bulb may be confined as soon as the bath reaches the required temperature. After this a very slight increase of temperature raises the mercury column sufficiently to close the electric circuit, and then the current shuts the cock which regulates the supply of gas to the burner under the bath. The chief advantage and the novelty of the apparatus is to be found in the simplicity of this stop-cock, which was suggested by Professor H. B. Hill. It consists of an ordinary chloride of calcium tube placed horizontally, and closed at the larger end by a rubber stopper, which allows a considerable freedom of motion to a smaller glass tube passing through it; by this the illuminating gas enters the chloride of calcium tube, from which it passes to the burner. When the current is closed, an electro-magnet acting on an armature attached to the outer end of the small tube plunges the curved inner end beneath the surface of some mercury in the bulb of the chloride of calcium tube, and thus shuts off the main supply of gas; although a small orifice in the side of the inner tube allows a sufficient flow to keep the flame under the air-bath alive. The variation of the temperature of the air-bath does not ordinarily exceed one or two degrees during periods of fifteen to twenty hours, even under great variations of pressure in gas mains.

United States Board for Testing Iron, Steel, &c.—The Committee for investigating those modifications of the various properties of the metals which are produced by changes of temperature, are desirous of supplementing their experimental researches with such results of other experimental work and of observation as may be obtainable from authentic sources; they, therefore, solicit such contributions from investigators and observers as may be deemed valuable as assisting in the task assigned them. The behaviour of rails and of machinery exposed to the extremes of temperature observed in northern latitudes, where exposed to wear or to breakage, will be likely to afford valuable data. The character of the fracture and the texture of the abraded surfaces, as well as the statistics ordinarily collected, should be noted. Specimens exhibiting peculiarities of behaviour or appearance, and photographs of masses which it may not be convenient to forward, will be of value. Where exact quantitative analyses of metals exhibiting unusual characteristics can be given, they will add effectively in the determination of the causes of such peculiarities. The statistics of well-managed railroads are expected to afford useful and reliable information. Rolling mills producing rails and other forms of rolled iron which are tested by the drop may be able to furnish more accurate statements of the effect of changes of temperature in modifying resistance to shocks. Some experimental work has already been done in this field, and it is desired that the results of such researches may be communicated in as great detail and with as much accuracy as possible. Published monographs, reference to papers published in scientific, engineering, or other periodicals, and unpublished papers, will be received as valuable contributions. All assistance rendered the Committee in the endeavour to ascertain the character of the change of the force of cohesion produced in the metals and their alloys by variation of temperature, to determine the mathematical expression of that law, and to obtain such formulæ, either exact or approximate, as will make these results conveniently and practically available to engineers and constructors, will be properly acknowledged. This Committee consists of Prof. R. H. Thurston (Chairman), L. A. Beardslee, and Q. A. Gillmore.

Metropolis Gas Supply.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently reported to the Corporation of the City of London, and the Metropolitan Board of Works the results of the daily testings of the gas supplied from the several gas-works of the Chartered, the Imperial, and the South Metropolitan Companies during the last three months, from which it appears that the average illuminating power of the gas at the several testing places has been as follows :—Common gas at Beckton, North Woolwich, 17·63 standard sperm candles; at Friendly Place, Mile End, 16·76 candles; at Ladbroke Grove, 16·97; at Carlyle Square, Chelsea, 16·62; at Camden Street, Camden Town, 15·76; at Graham Road, Dalston, 16·82; at Bruce Terrace, Bow, 16·27; and at Hill Street Peckham, 15·70. The Cannel Gas of the Chartered Company at Millbank

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Street, Westminster, has been equal to 21·13 standard candles. In all cases and at all times the illuminating power of the gas has been equal to the requirements of the several Acts of Parliament. As regards purity Dr. Letheby reports that the gas at each of the testing places has been constantly free from sulphuretted hydrogen, and that the average amounts of sulphur in other forms than this have ranged from 9·04 grains per 100 cubic ft. to 18·28 grains, the following being the average proportion at the several testing places:—Beckton, 10·35 grains; Friendly Place, 9·42; Ladbroke Grove, 10·40; Millbank, 11·06; Carlyle Square, 18·28; Camden Street, 12·69; Graham Road, 13·35; Bruce Terrace, 9·04; and Hill Street, Peckham, 13·42. All these averages are below the prescribed quantities, but on one occasion the gas at Friendly Place contained an excess of sulphur, and the same was the case with the gas at Hill Street. On 14 occasions the gas at Carlyle Square was overcharged with this impurity, and on 7 occasions at Camden Street. At both of these places the excess has been the subject of appeal by the Imperial Gas Company, and the Chief Gas Examiner has certified that in the case of the gas at Carlyle Square, the excess of sulphur was occasioned by the unavoidable derangement of the purifier during the alterations which were being made at the works of the Company for the purpose of meeting the necessities of the ensuing winter; but in the case of the gas at Camden Street the excess of impurity was not the result of unavoidable cause or accident. The proportion of ammonia in the gas at all the testing places excepting Millbank has not exceeded the prescribed quantity of 2·5 grains per 100 cubic ft. At Millbank, however, there was an excess of this impurity, ranging from 4 grains to 6 grains per 100 cubic ft. of gas on four occasions.

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London: Boy Court, Ludgate Hill, E.C.

THE QUARTERLY JOURNAL OF SCIENCE.

Edited by WILLIAM CROOKES, F.R.S., &c.

No. XLVII., *July*, 1875, price 5s.

CONTENTS.

I. Variation in the Obliquity of the Ecliptic. By Col. A. W. Drayson, R.A., F.R.A.S., &c.
II. The Rights of the Thinker.
III. Another View of Levitation.
IV. The History of our Earth.
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COMMITTEE ON COMMERCIAL PHOSPHATES AND POTASH SALTS.

The Committee beg to thank those Chemists who have already returned their Circulars, and will feel greatly obliged to any others who may be in a position to give information if they will forward their replies as soon as possible to the Hon. Secretary, Alfred H. Allen, 1, Surrey Street, Sheffield.

"YOUNG" CHAIR OF TECHNICAL CHEMISTRY, ANDERSON'S UNIVERSITY, GLASGOW.

This Chair is now Vacant, by the resignation of Professor Bischof. Intending Candidates will receive information from the subscriber, with whom Applications and Testimonials may be lodged on or before 16th August proximo.

ALEX. MOORE,
Secretary to the Trustees.

166, St Vincent Street,
July 7, 1875.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 817.

IMPLEMENTS FOR FILTRATION.*

By P. CASAMAJOR.

I.—*Filter Pump.*

In the *American Chemist* for April, 1874, I gave a description of a new apparatus which may be used as filter-pump or laboratory bellows. Since sending this communication I have used this apparatus almost constantly as filter-pump, but having very seldom to use it as bellows I have disconnected the two portions, and tacked the part which forms a filter-pump to the wall over a sink into which the water runs after leaving the aspirator. The portion used as bellows is, as explained in the article mentioned, a bottle closed by a cork having two holes, one to admit the aspirator, and the other a tube for carrying off the air. There is at the lower part a nozzle for getting rid of the water after the bubbles of air have been separated from it. As now mocified, the cork which closes the mouth of the bottle bears two tubes, one reaching to the bottom and the other starting from the top of the bottle. This latter tube carries off the air, while the other, when the apparatus is in use, must be connected with the tube which carries away from the aspirator the water charged with bubbles of air. Beyond this brief mention we do not propose to call attention any further to this blowing apparatus, as it has no relation to the subject of filtration.

The filter-pump itself is very easily put up by using elements which are at hand in every laboratory, which circumstance induces me to call attention to it again, particularly as it has been much improved, and the results now accomplished are much superior to those previously announced. To give an account of the changes adopted I propose to give a brief description of this aspirator, and afterwards to call attention to the points that are of most importance if advantageous results are to be obtained.

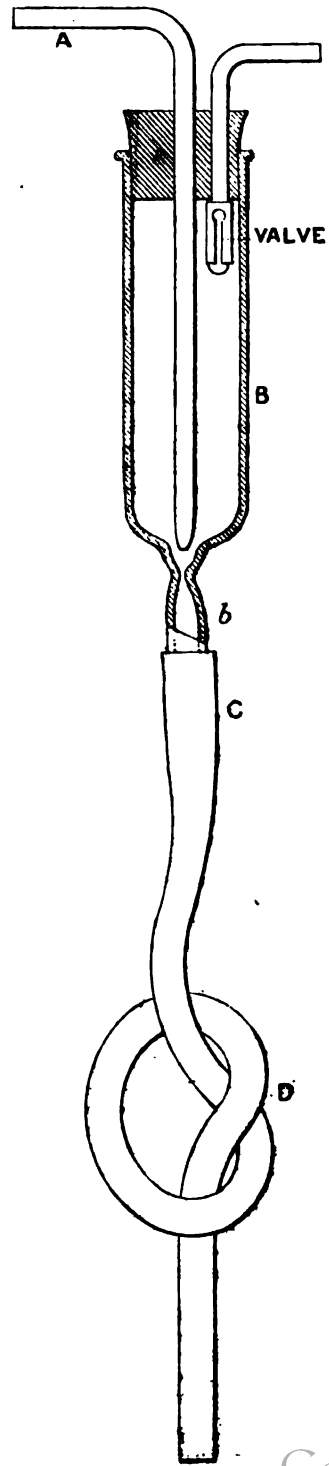
The aspirator, as now used, is represented in Fig. 1, in which A is a tube which conveys water from the hydrant or from an upper reservoir. The extremity of this tube, through which the water escapes, has a contracted outlet, which gives increased velocity to the water as it enters the tube *b*, which forms the lower part of the vacuum chamber B. To the tube *b* is attached a rubber tube C, which is curved at D into a loose knot. The lower portion of C hangs over a sink into which the water is discharged after leaving the apparatus. Through the cork, which carries the tube A, passes also the vacuum tube E, which establishes a communication between the vacuum chamber B and the bottom of a funnel or a bell glass.

The first point of importance to be attended to, if we wish to obtain good results, relates to the shape of the lower extremity of tube A and to the size of the opening for the egress of the water. The best results have been obtained by making the lower end of A somewhat truncated (see Fig. 2), and making the hole in it not more than $\frac{1}{32}$th of an inch in diameter. The tube should be elongated by heating over a flame until the interior diameter is reduced to about $\frac{1}{16}$th of an inch. A cut with a file will sever the tube, after which the portion which is to form the extremity of A has to be heated again until the glass is softened, when, by pressing the end of the tube against any hard surface, it will become blunted and the hole will become contracted. The object of flattening the end of tube A is to cause the water to come out of the opening somewhat obliquely, which makes a better vacuum than when the water escapes from an elongated cone. The opening for the escape of the water is reduced to allow the pump to work with a smaller supply.

* Communicated by the Author.

The tube *b*, which forms the lower portion of the vacuum chamber B, should be drawn to a diameter of about $\frac{1}{16}$th of an inch at the narrowest part, which ought

Fig. 1.



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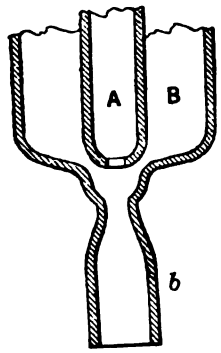
to be immediately below the lower end of tube A, as shown in Fig. 2.

To the lower portion of tube *b* is attached a piece of rubber tubing loosely knotted, of which we have already spoken. The knot formed by this tube acts as a trap, which remains full of water while the aspirator works,

Fig. 2.



and prevents the introduction of air from below to satisfy the vacuum in vessel B.* This object I sought to accomplish formerly by dipping entirely in water the end of the tube carrying the water away from *b*; but this course is objectionable, for, whenever the pressure in the tube A diminishes, and the impact of the water on the tube *b* is not sufficient to maintain the vacuum in the chamber B, the water from below rushes up into the vacuum chamber, and when the tube which is a prolongation of *b* dips into a large body of water the vacuum chamber itself—and every vessel communicating with it—is in danger of being flooded. The advantage of using the trap formed by recurving the tube C is, that the quantity of water held in the recurved portion is only sufficient to fill a portion of the vacuum chamber whenever the water rushes up into it.

I have said that this aspirator may be constructed by using elements which may be found in any chemical laboratory. The only apparent exception to this is the vacuum chamber B, with its appendage, the tube *b*, but the difficulty of obtaining this piece is easily overcome by making the tube *b* of an independent piece of tubing, and connecting it to a vacuum chamber by passing it through a cork. The vacuum chamber may then be made of a glass tube having a diameter of 1 inch or 1¼ inches, and closed by corks at both ends, the upper corks carrying the tubes A and E, while the lower cork will bear the tube *b*.

Many vessels may be utilised for making up the vacuum chamber B and its annexed tube *b*; I may cite as an instance a filter-pump I have in use, in which the vacuum chamber is a cylindrical bottle having a diameter of 1¼ inches and a length of 5 inches—such a bottle as is used for exhibiting samples of refined petroleum. The bottom was knocked out by dropping an iron rod into the bottle, which operation left an opening which is now closed by a rubber stopper bearing the tubes A and E, while through the ex-mouth of the bottle passes the tube *b*. As the difference between the interior diameter of the opening and the exterior diameter of the tube *b* is only ¼th of an inch, the space has been filled by passing the tube *b* through a piece of rubber tubing before inserting it in the vacuum chamber.

The vacuum chamber B may be of smaller dimensions than the one I have just cited. It is necessary, however, that its diameter should be sufficient to admit of its being closed by a cork capable of carrying both the tubes A and E. The capacity of the vacuum chamber should be such that the water in the recurved rubber tube may find room in it whenever the flow in the tube A is suddenly checked.

To maintain the vacuum beyond the vacuum chamber, when the flow of water is checked or diminished, it is necessary to place a valve on the tube E. The valve adopted (see Fig. 1) is of the simplest description, and requires only a few minutes to construct it. It is made by closing the end of a glass tube by melting over a lamp, and on the side of the tube, about an inch from the end, making a hole with a file previously dipped in petroleum to prevent it from cracking the tube. Over this glass tube we then slip a rubber tube about an inch long and having a longitudinal slit about ¼ of an inch long. About one-quarter of the length of the rubber tube is left entire, which forms a ring to retain the rubber on the glass tube. The slit should be placed diametrically opposite the hole made on the side of the glass tube. When placed in this manner the rubber tube may be considered as a loose flap placed over the hole; it opens out when air is blown into the tube, and closes when the air is sucked out. To ascertain the best place in which to place the rubber tube over the opening, a few trials are necessary, by blowing and aspirating at the open end of the glass tube. If the hole in the glass tube is too near the ring or entire part of the rubber tube, the valve will not open when the air is blown in, while, on the other hand, if the side hole is too far from the ring, the valve will not close when air is aspirated from the tube. To prevent the slit from extending in time the whole length of the rubber tube, it should terminate at the end near the ring, in a round hole or a transversal slit.

In the description of this aspirator previously given (*American Chemist* for April, 1874), I said that it could only be used when the pressure in the hydrant was very high. I have, however, obtained very good results with moderate pressures since the improvements which have been described in this article were adopted.

The following table shows the results for different pressures:—

Pressure in the Hydrant in lbs.	Vacuum in inches of Mercury.	Water spent per minute in litres.
2	2¼	0·50
4	3¼	0·75
8	5	1·00
16	10¼	1·33
20	16¼	1·45

I use habitually a pressure of 8 lbs., which produces all the necessary effects without straining the rubber pipes which connect the hydrant faucet to the tube A.

In calling attention to this simple and effective apparatus for the second time, I wish to have it well understood that I do not claim to have discovered any new principle or any application of a principle. My object has merely been to afford directions to enable any chemist, who desires to have a filter-pump, to make one for himself, in a short time and at a small expense.

(To be continued).

* This trap is useless if the aspirator is well constructed; otherwise it increases the vacuum, but in no case is it hurtful.

ON THE WIDE DIFFUSION OF VANADIUM AND ITS ASSOCIATION WITH PHOSPHORUS IN MANY ROCKS.*

By A. A. HAYES, M.D.

CHRISTIAN KEFERSTEIN, as early as 1834, had boldly stated the proposition that "all crystalline non-stratified rocks, from granite to lava, are products of the transformation of sedimentary strata," and later researches aid in confirming the truthfulness of this view.

Simply considered, all rocks consist of a basis material, generally simple minerals, such as compound silicates, aluminates, or even quartz, in various states of division,

* A Paper presented to the American Academy of Arts and Sciences

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united by a compound which acts the part of a cement, which through its composition is more easily acted on by ordinary agents than the particles of the mineral it unites.

This part of every rock engages attention, also, from its acting as a positive compound does in a simple mineral. It is complex in composition; usually it consists of silicates of protoxide bases. At one moment of time it binds the particles with great force; at another, under altered conditions, it relaxes its bonds, itself losing cohesion, crumbling and becoming an earth containing the elements necessary to vegetation, while the bonded materials drop to their condition before union.

Accepting Keferstein's expression in its fullest sense, I have applied the resources of analysis to a large number of rock aggregates, and the result of my experiments have shown the interest and extent of this field of inquiry. To do this, I have departed from the ordinary course of analysis, and applied a principle which, many years since, enabled me accurately to separate alkalies from mineral compounds. This principle is the adaptation of a definite mixture of agents, so that while one part of the mixture is searching for and dissolving the substance to be studied, the other part is holding in a semi-fluid state the larger part of the substance and allowing any reactions or adjustments of composition to take place. The subsequent solution and boiling determines the precipitation of compounds not soluble in the medium. This medium is subsequently decomposed and products divided.

Mode of Analysis.—The rock perfectly cleansed by washing and brushing, reduced to fine powder, is either dried for its combined water or taken in its natural state. A flux is prepared by melting 202 parts of potassic nitrate with 53 parts of sodic carbonate, both pure. The cooled mass, reduced to powder, absorbs about 0·004 part when exposed to the air, and must be kept in a closed bottle. This *basis* flux can be adapted to meet all cases of varied composition in minerals. 1 grm. of the rock or mineral is mixed intimately with 1·28 grms. or 2 grms. of this flux in a tall, narrow crucible of platinum, on which no action is exerted. The crucible, covered, is heated over an ordinary Bunsen table lamp, gently while intumescence continues: the heat increased, hissing ceases, a slow sintering follows, and in 12 to 20 minutes the action is over, about one-half of the whole power of the lamp being used.

The fused mass, mostly removed from the crucible by a looped platinum wire, with the crucible and cover are boiled in water. The basic silicates, more or less altered, remain; the soluble compounds dissolve, and the filtered solutions and washings, making 40 to 50 cc., are evaporated in a platinum basin to about 6 cc. To the hot solution, ammonic chloride, a little in excess of the equivalent of sodic carbonate used, is added, from a titrated pure solution, the basin put on a water-bath, the contents evaporated, and carefully dried at temperature not exceeding 100° C. After the addition of the ammonic chloride, the silicic acid gelatinises, and, in drying, passes out of combination with the alkalies. By subsequent boiling in water and filtration, the precipitated silicic compounds are obtained.

The filtrate and washings contain other combinations, which can be treated either in the normal state of acid ammonic salts, or after the addition of a drop of ammonic hydrate renders the solution neutral to test-paper. Numerous cases occur, rendering modifications necessary. Chlorine, bromine, iodine, sulphur, compel a choice of ammonic salts. Many of the acid-forming metals are separated by their characteristic reactions from the residue of fusion. In general, if the solution of the result of fusion does not deposit silicic acid on the addition of an ammonic salt, 0·25 grm. of silicic acid, with or without its equivalent of sodic carbonate, is added; because the displacement of other acids depends on the presence of an excess of silicic acid. The solution containing nitrites is delicately balanced, but it is always adapted to the statical determination of phosphoric acid by the magnesia mixture, or its estimation volumetrically, in using uranic nitrate. The quantity of phosphoric acid present in mineral or artificial forms of compounds can thus be accurately obtained, and the most compact aggregates do not resist solution.

Wide Distribution of Phosphorus.—In applying this mode of analysis to a great variety of rocks, it soon became evident that phosphoric acid is widely distributed. In some cases the basis, as well as the cementing part, of a rock contained it, so that adherence to the plan of seeking it in classified rocks was not possible. Associated with silicates of the more basic earths and the protoxides of metals, it is found in all the clays, the new and old lavas, trachytes, slates,—from the most fissile to the most compact,—shales, ashes of coals; in the rocks formed of quartz, felspar, and mica; in aggregates where felspar is replaced by quartzite, and in those containing chlorite. The well-known conglomerates of Roxbury, and a siliceous slate reposing near it, contain phosphates.

In the opaque felspars, the ancient porphyries of Rome and Carthage, phosphates occur; but the glassy and rose-coloured varieties have not afforded it. The lepidolite of Paris, Me., contains it; furnace products, slags from copper and zinc, afford it. This list might be extended, without indicating any law relating to the affinities, which may perhaps be discovered as the observations are multiplied. We have in phosphatic salts in rocks another consolidating material, and an element of change.

Vanadium Associated with Phosphorus.—In many of the analyses made after the method described, another acid was found associated with phosphoric acid, and this was easily proved to be a compound of *vanadium*. The frequency of its occurrence as acid or oxide, its well-marked characters as a changeful body, the colours of its compounds and mixtures, give great interest to this discovery. Owing to its association with proto salts of manganese and iron in rocks, it proves to be active, first as a binding, and secondly as a disintegrating, agent. It is a matter of surprise that the dissemination of vanadium has not before been noted, especially since its later classification with phosphorus leads to such a conclusion.

When the rocks treated by the above method for phosphoric acid contain manganic compounds, if the second filtrate, balanced by ammonic salts, has any yellow tint, vanadic acid salts are almost surely present. It occurs with phosphoric acid in most of the mineral bodies named above. The physical character of colour of the rock is the only indication I now know. The green and plum colours of slates and porphyries; the greenish epidote colour of many aggregates; the changed colours seen in sandstones, and especially in roofing slates, from world-wide localities, are guiding marks merely. My observations have been quite numerous, and as yet no proper *ore* of vanadium has been found, but sources of economical separation have been suggested.

As vanadium occurs in many well-trodden paths, I deemed it important to devise a direct way of obtaining it, in which no metal and the fewest reagents are employed.

Process.—Crush in the diamond mortar 1 to 1½ grms. of greenish slate to a fine and coarse powder; place in a watch crystal, and wet thoroughly with a solution of one-fourth sulphuric hydrate, leaving a little excess. Expose freely to dry, warm air,—sunshine, if possible; and, if the slate is acted on, after 2 to 4 days, when the mass is nearly dry, the salts formed crystallise. Under a lens, a number of green or bluish-black spherical crystalline aggregates, unlike any other matter present, will be seen. These are a double salt, in which blue oxide of vanadium exists; and from such a small weight often enough crystals can be picked out for showing the characters of vanadium compounds. It is best to use several differing specimens, which by their colours indicate proto-silicates,

and to be sure that they have been carefully washed, as granites are often invested with a lichen of a hemispherical form. One is often surprised to see the number of these crystals extruded from the mass of salt, and formed under constraint. The oxidised rocks do not afford these crystals, but we see bands of yellow vanadium compounds, denoting the condition of the substance.

The ordinary tests of vanadium are best applied to the vanadates, and among them the gall test is delicate and discriminating. If the greenish-black precipitate it forms in acid solutions be burned, the insoluble oxide obtained (when the precipitate is entirely free from any chloride) has characteristic reactions with acids, and in the blowpipe flame with fluxes. The salts of vanadium in mixture with manganous salts, precipitated by excess of ammonic hydrate, afford a blue solution above the oxides, rivalling that of cupric oxide.

By oxidising the blackish-blue salt obtained by sulphuric hydrate, the yellow compounds form, and may be tested under both modifications.

The vanadate of ammonia present in the balanced solution from the silicates, by the mode of analyses described above, may be separated by over-saturating the solution with ammonic chloride, when ammonic vanadate separates; although phosphoric acid is present. From the vanadate other combinations of vanadium may be formed. The solution does not then respond to the gall test; and the ammonic vanadate separated, when heated, leaves vanadic acid. The deposit caused by tinct. galls may be calcined for V_2O_4. In testing for phosphoric acid, in this mixed solution, the magnesia mixture does not respond at once, unless the device of Wollaston be used; and, in strong solutions, plumose vanadates form. If heat is applied to the salts in mixture with chlorides, much of the vanadium will be lost. In most of the rocks containing phosphorus, vanadium has been found associated. Manganese is also a congener; and, without repeating here the list of rocks, I can promise in a future paper to give a tabulated series.

In Utah, in the Tintic district, there is a chalcedonic rock, with brown ferric and cupric ore. In the brown part of this ore both phosphorus and vanadium are abundant. The presence of vanadium, in crusts on copper rock of Lake Superior, announced some years since, by my late friend J. E. Teschemacher, has been lately confirmed. It is present in light greyish earth-like substance of the datholite beds in the Calumet and Hecla mines. At present it appears that vanadium is as common a constituent of rocks as manganese.

Vanadic Compounds in Water.—The beautiful suburb of Boston, Brookline, owes its varied surface and scenic effect largely to *water action* in forming the gravel drift into elevations and depressions, having curved and graceful lines. This drift presents us with a magazine of rock aggregates, which not only supply the laboratory, but, in various cuttings, allow us to watch the influence of air, frost, and water on the rocks; which, stable in their beds, become changed, even rapidly, on exposure to these agencies. This gravel, permeated by air, changing under every variation of pressure, is powerfully oxidising; and the rain water, even if coloured on entering it, becomes colourless and sparkling at eight yards below the surface. The gravel contains strata and inclined dykes of extremely finely divided micaceous earth, or "quicksand," in which the water circulates and passes to the ocean at different levels. An *average* result of partial analyses is:—1 litre affords by evaporation and drying at 100° 0·350 grm., of this amount 0·182 grm. is nearly insoluble matter; 0·168 grm. again dissolves in water, and contains, besides the ordinary salts, soluble silicates, not altered by boiling, drying, or heat of 100° C. These waters attack crystal glass, leaving an incrustation, which resists weak acids; and they seem to be free to act in re-consolidating strata. Indeed, in the deep parts of the gravel deposits, we meet with masses of rock in which solution of the silicates in water is hourly going on; and we may follow these solutions to the wells, and observe that sometimes depositions are formed on the surfaces of the rocks, over which they pass.

Vanadium exists in the water, which supplies the wells of the district of the drift, as a transparent, colourless solution of magnesian calcic, manganous, and ferrous silicates, phosphates, carbonates, and vanadates.

The deposit which forms in the boiling water resembles in composition the matter as taken from rocks by weak solvents, although some of these compounds remain dissolved in the water after it has been boiled.

Detection of vanadium as oxide is easily and at once effected, by dissolving the deposit formed from boiling water, by means of diluted nitric or sulphuric hydrate. In this solution, the addition of a slight excess of ammonic hydrate, and a moment after a considerable excess of ammonic carbonate, insures the reduction of any vanadic compound, by the manganous and ferrous oxides, and separation of other compounds than magnesic oxide and the blue vanadous oxide, which appears in solution of a rich blue colour. In a nearly closed vessel, a bright strip of zinc will withdraw vanadous oxide from the blue solution, at first as a thin bronze coating, then after a black crust.

I believe this is the first discovery of vanadic compounds in water. Before announcing it, every source of error has been scanned; and the labour of connecting the compounds with the rocks where they originate has been performed, as necessary to completeness, in the evidence.

Manganous salts have been observed in waters where humic acid has acted on rocks containing manganous carbonate, and the existence of a water of this kind is known to me; but it must be considered quite apart in composition from a water in which soluble silicates include manganous silicate as part of a compound possessing novel characters.

In concluding this brief account of results proving the existence of phosphates and vanadic compounds in the cementing material of the most common rocks, I wish it to be considered as only introductory to a wide field of interesting research.

OUTLINES OF A BIBLIOGRAPHY OF THE HISTORY OF CHEMISTRY.*

By H. CARRINGTON BOLTON.

To study a subject advantageously and satisfactorily, the first requirement is a knowledge of the literature on that subject; in this belief we have compiled a catalogue of works on the history of Chemistry, for our own use and that of those who may be interested in the origin and development of this science. So far as we know, no bibliography of the kind exists, and as the materials for such a list are widely scattered the difficulty incurred is not inconsiderable. In the following catalogue we lay no claim to completeness, but desire that it should be regarded rather as an outline to be filled up by others having greater bibliographical experience and larger facilities for research.

This bibliography is confined to independent works; the numerous essays relating to the history of specific branches of chemical science, widely disseminated throughout periodical literature, are not included; we have inserted, however, the few catalogues of chemical books, which, though not embraced by the title of this compilation, are too important adjuncts in the history of chemistry to be omitted.

Nearly all encyclopædias and dictionaries of science contain articles on chemistry from a historical point of view, under the word "alchemy;" references to these would needlessly expand this bibliography, and have been omitted. We may here mention, as noteworthy, the

* From the *Annals of the Lyceum of Natural History*, N. Y., vol. x.

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article on alchemy in the "Encyclopédie Méthodique," Paris, 1792; in the "Allgemeine Encyclopædie der Wissenschaft und Künste," by J. S. Ersch und J. G. Gruber, Leipzig, 1818; in Rees's "Cyclopedia, or Universal Dictionary of Arts," Edinburgh, 1819; and in the "Handwörterbuch der reinen und augewandten Chemie," of Liebig, Poggendorff, and Wöhler, Braunschweig, 1857.

If undue consideration appears to be given to the history of alchemy as distinguished from chemistry proper, our readers will bear in mind that the *early* literature of chemistry is almost wholly devoted to the hermetic art. Alchemy is sometimes regarded as the dishonourable parent of a noble offspring, and has been sarcastically defined as: Ars sine arte, cujus principium est mentiri, medium laborare, finis mendicare;"* an art without art, originating in falsehood and proceeding through labour to beggary. We agree, rather, with the British historian of chemistry, who remarks that, "Alchemy, or the art of making gold, furnishes too curious a portion of the aberrations of the human intellect to be passed over in silence," and we confess to a partiality for the study of the vagaries of the gold-makers, and to finding a fascination in tracking their mysterious footsteps.

Finally, a word of apology with regard to the annotations. In order to make the bibliography instructive and somewhat more readable than such compilations usually are, we have ventured to add brief remarks in connection with the less known publications, giving some account of the author and the nature of his work. In expressing an opinion with regard to the merits of a work we disclaim any intention of assuming the position of a standard in criticism, but we believe that the opinion of an individual may be of some value, even though the views taken are diametrically opposed to the judgment of others. We have an honourable precedent, moreover, in the "Bibliotheca Bibliographica" of that learned bibliographer, Julius Petzholdt.

The works which follow are arranged in chronological order:—

Hoghelande, Theobald van. *Historiæ aliquot transmutationis metallicæ pro defensione alchymiæ contra hortium rabiem.* 8vo. Coloniæ, 1604.

Schmieder remarks that Hoghelande was an important personage in the history of alchemy, for after experiencing serious doubts of the transmutation of metals he became a vigorous defender of the faith, and freely made his convictions known. This essay is a collection of marvellous tales concerning veritable (?) transmutations. A German translation also appeared under the title: "Beweis das die Alchymey oder Goldmacherkunst ein sonderbares Geschenk Gottes sei." 8vo. Leipzig, 1604.

Conring, Hermann. *De hermetica Ægyptiorum vetere et Paracelsica nova medicina.* 4to. Helmstadtii, 1648. (Second edition in 1669.)

Conring bitterly attacks the extreme antiquity assigned to alchemy, and provoked the reply by Borrichius, noticed below.

Borel, Pierre. [Borellus.] *Bibliotheca chimica, seu Catalogus Librorum Philosophicorum Hermeticorum.* Auctore Petro Borellio. Parisiis, 1654.

The first extensive catalogue of chemical books. Contains four thousand authors.

Kircher, Athanasius. *De Origine Alchymiæ;* also *De Lapide Philosophorum.* In *Mundus Subterraneus, Vol.* II., *Liber* XI., *Sectio* I. *et* II. Folio. Amsterodami, 1665.

Athanasius Kircher, a celebrated historian, philosopher, mathematician, and physical philosopher, was born at Fulda, in 1601, and died at Rome in 1680. He filled the chairs of philosophy and oriental languages in the College of Wurtzburg and in the Jesuit's College at Avignon. He was afterwards professor of mathematics in the Jesuit's College at Rome. Kircher was a man of "wide and varied, but ill-digested erudition, and a most voluminous writer." Although credulous to an absurd degree, in the dissertation "De Origine Alchymiæ," he violently attacks the alchemists and their pretended transmutations of the baser metals into gold. It is reprinted in Mangetus's "Bibliotheca Chemica Curiosa," where also replies to his attacks, by Clauder and by Blauenstein, are found.

Cooper, William. *A Catalogue of Chymicall Books, in 3 Parts, collected by William Cooper.* 12mo. London, 1675.

Borrichius, Olaus. *Dissertatio de ortu et progressu Chemiæ.* 4to. Hafniae, 1668. (Reprinted in the Bibl. Chem. curiosa of Mangetus, Vol. I., No. 1).

The author of this celebrated treatise, the most frequently quoted by succeeding historians, was born at Borchen (whence his latinised name), Jutland, in 1626. He was Professor of Philosophy, Poetry, Chemistry, and Botany, at the University of Copenhagen, a fact which causes Rodwell to remark that, "either Professors were difficult to procure in the Kingdom of Denmark, or else Olaus Borrichius was an astounding genius." However this may be, he was certainly a man of amazing credulity, and allowing "the imaginative faculty due to his poetical temperament, to exert an undue influence over his sober judgment," he refers the origin of alchemy to the antediluvians, endeavours to prove that Hermes Trismegistus was a real personage, the inventor of all arts, and the father of alchemy. and that the Smaragdine Table was really found by the wife of Abraham, besides accepting the preposterous theories of his contemporaries concerning the elixir of life and the philosopher's stone. This dissertation was highly prized by the alchemists of his day on account of its earnest defence of their principles.

Its present value is solely that of a curious example of the extravagant credulity of a learned man. According to Wiegleb, Borrichius's work may be accounted the first history of Chemistry (Alchemy).

Morhof, Daniel George. *De Transmutatione metallorum Epistola ad virum nobilissimum Joelem Langelotum.* 8vo. Hamburg, 1673. (Reprinted in Mangetus's Bibl. Chem. curiosa, Vol. I., No. 9; also appeared in German, under the title: "D. G. Morhof's Abhandlung vom Goldmachen." Baireuth, 1764).

Morhof, born 1639, died 1691, was Professor of History at Kiel. Schmieder calls him an unprejudiced historian.

Borrichius, Olaus. *Hermetis, Ægyptiorum et chemicorum sapientia ab Herm. Conringii animadversionibus vindicata.* 4to. Hafniæ, 1674. (Reprinted in Mangetus's Bibl. Chem. curiosa, Vol. I., No. 2).

Borrichius, Olaus. *Conspectus scriptorum chemicorum.* 4to. Hamburg, 1697. (Reprinted in Mangetus's Bibl. Chem. curiosa, Vol. I., No. 2).

Manget, Jean Jacques. [Mangetus.] *Bibliotheca Chemica curiosa, seu rerum ad alchemiam pertinentium Thesaurus instructissimus.* * * * Genevæ. 2 vols. Folio. 1702.

A collection of one hundred and thirty-three rare tracts on alchemy are here reprinted. Contains many bibliographical notes.

Roth Scholtz, Friedrich. *Bibliotheca Chemica; h. e. Collectio Auctorum fere omnium qui de naturæ arcanis, re metallica et minerali * * hermetice scripserunt.* * * * 5 parts. 8vo. Norimbergæ, 1725—33.

The work of a Nuremberg bookseller well versed in literature. Contains the greater part of the work of Borel, which had already become scarce. Is, however, incomplete, extending only to the letter H.

(To be continued.)

* Harris, in Rees's "Cyclopedia."

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SOCIETY OF PUBLIC ANALYSTS.

THE MILK QUESTION.

To the Editor of the Chemical News.

SIR,—Dr. Campbell Brown explains in his letter (*vide* CHEMICAL NEWS, vol. xxxii., p. 28) that when he wrote his paper on "The Minimum of Solids in Milk," his object was *not* to controvert any of my statements, but that in writing the letter his object is to controvert my statements. And it was not without reason that the learned Doctor offered an explanation, for when the Doctor wrote in the abstract (*vide* CHEMICAL NEWS, vol. xxxi., p. 266) he wrote:—

"The following three samples are the poorest authentic samples out of three or four hundred which I have examined;" and after detailing certain particulars relative to the date, &c., of these three samples of milk, he gave the analyses of them as follows:—

	Total Solids.	Cream. Per Cent.	Fat.	Solids not Fat.
No. 1. ..	11·10	under 8	2·16	8·94
No. 2. ..	11·36	about 9	2·41	8·95
No. 3. ..	11·55	—	2·74	8·81

But when the Doctor writes to controvert me, his analyses (*vide* CHEMICAL NEWS, vol. xxxii., p. 28) are as follows:—

	Total Solids.	Fat.	Solids not Fat.
No. 4. Average sample from several well-fed cows on a rich farm in Cheshire; *March*	12·90	4·40	8·50
No. 5. Country milk; *February* ..	12·35	3·74	8·61
No. 6. Cheshire milk, stall fed; *January*	12·46	4·00	8·46

I have italicised the dates of these milks in order to call attention to the circumstance that they were before the date of the paper on "The Minimum of Solids in Milk," and not in the interval between the Doctor's paper and his letter.

Having these analyses in his possession at the time of his writing the paper, why did he not publish them? I think I can give the real answer. I believe that he had no confidence in them when he wrote his paper; and when he tells us that instead of drying up 5 grms. of milk he is in the habit of drying up 40 or 50 grms., we cannot wonder at his getting anomalous results.—I am, &c.,

J. ALFRED WANKLYN.

117, Charlotte St., Fitzroy Square, W.
July 19, 1875.

THE MILK QUESTION.

To the Editor of the Chemical News.

SIR,—I have read with interest, as all chemists are likely to do, the article and letter in the CHEMICAL NEWS, vol. xxxii., p. 26, referring to Dr. Voelcker's celebrated lecture before the Farmer's Club. Shortly after its delivery I gave my reasons for doubting many of the statements made by the learned Doctor, but my criticisms were addressed to a journal in which the report of the lecture appeared.* The lecture in question contains such palpable errors that grave doubt must be thrown on the accuracy of the remaining conclusions.

Among other assertions capable of absolute disproof, Dr. Voelcker says—"Milk purposely watered yields only 5 to 6 per cent of cream, and has invariably a lower specific gravity than 1·025." Now, I make it a point to ascertain, with accuracy, the specific gravity of every milk which passes through my hands. The determination is usually made with a hydrometer, but occasionally with a bottle. The former has been carefully verified and found accurate. The temperature I employ is 15·5° C. (=60° F.). Ascertained in this way, the gravity of a considerable number of samples of adulterated milk has frequently reached 1·027 to 1·029, and has rarely been less than 1·024 or 1·025. It may be asked how I know with certainty that such milk was adulterated? The reply is, that in the majority of cases the milkmen admitted having added water, and in others the other results of analysis were such as would suffice to convince anyone but Dr. Voelcker. Yet, according to the Professor, who believes that he has "had as much experience in the examination of milk as anybody in England," "within certain limits the specific gravity is the most trustworthy indicator of quality."

After making this statement, it is rather startling to find that Dr. Voelcker gives the figures 1·0295 and 1·0257 as the average densities of milk adulterated with 10 and 20 per cent of water respectively!* It appears, therefore, that Dr. Voelcker believes that milk-dealers "invariably" add more than 20 per cent of water when they adulterate milk, for how, otherwise, could he assert that "milk purposely watered has invariably a lower specific gravity than 1·025."

Taking the figures of Dr. Voelcker's table, it appears that milk containing 25 per cent of added water would have a gravity of 1·0245, which is very slightly different from 1·025, which he takes as his lower limit of density for genuine milk. Yet, in his evidence before the House of Commons Committee (Question 5512), Dr. Voelcker expressed an opinion quite incompatible with the above statement. "In the case which I alluded to, half a pint of water had been mixed with a pint and a half of milk, and you think that adulteration to that extent ought always to be detected?—With the greatest facility."

Dr. Voelcker also argues that the presence of an unusual amount of cream cannot lower the density of milk to the same extent as the addition of water, and immediately afterwards gives a table of results from which a diametrically opposite conclusion is deducible. Thus, taking the percentage of cream on the milk at 10 per cent, which Dr. Voelcker says is about the average, it appears from the table that the process of skimming raises the density from 1·0314 to 1·0337. It must therefore be conceded that the addition of 10 per cent of cream to the original milk should have an equal but opposite effect,—that is, should lower the gravity by 1·0337 less 1·0314, equal to 0·0023. Dr. Voelcker's table shows that the addition of 10 per cent of water instead of cream reduces the gravity from 1·0314 to 1·0295, a difference of only 0·0019 as against 0·0023 produced by cream.

Dr. Voelcker appears anxious to prove the truth of certain fanciful notions, and if his facts are in opposition to his hobbies, why "so much the worse for the facts."

Although Dr. Voelcker puts the average amount of cream at 10 per cent, he says that "Milk purposely watered yields only 5 to 6 per cent of cream." It is evident that, to effect this change, the adulteration would have to amount to 40 or 50 per cent.

Dr. Voelcker's analyses go to show that by half-starving the cows they can be made to give milk as much as 2 per cent poorer in solids than had ever been observed before, and the lecturer was careful to point out that "as the milch cows were kept entirely for the use of the College, there can be no doubt of the genuineness of the supply." Unless the process of milking was most carefully watched, and *completed*, I contend that the evidence of genuineness is such as ought not to be accepted, and that in the face of the anomalous results of analysis there is *prima facie* reason to believe that the samples were either taken from the first portion of the runnings or were actually watered. It

* *Pharmaceutical Journal*, March 28, 1874, p. 788.

* Dr. Voelcker gives the following table, showing accurately the specific gravities, at 62° F., of milk before and after skimming, and of samples *purposely prepared* so as to contain different quantities of added water.

	Before Skimming.	After Skimming.
Pure milk	1·0314	1·0337
With 10 per cent water ..	1·0295	1·0308
With 20 per cent water ..	1·0257	1·0265
With 30 per cent water ..	1·0233	1·0248
With 40 per cent water ..	1·0190	1·0206
With 50 per cent water ..	1·0163	1·0175

From the *Pharmaceutical Journal* for March, 14, 1874, p. 744.

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must be remembered that the experiments were made some dozen years ago, and, taken in conjunction with the general looseness of statement which characterises the lecture, it appears highly probable that the collection of the samples was made in an equally slovenly manner.

Dr. Dupré very truly observes that the analyses in question were made "at a time when milk analysis was certainly much less understood than it is now, and by means of methods of which we know nothing," and he calls "upon Prof. Voelcker to publish the exact methods by which his results have been obtained."

Leaving Dr. Voelcker to reply or not, at his discretion, it may not be uninteresting to notice the method of milk analysis in the new edition of Normandy's "Chemical Analysis," which was "kindly supplied for this work by its author, Dr. A. Voelcker, F.R.S. In this scheme it is recommended to weigh out 500 grains of milk (!), coagulate it with a few drops of acetic acid (!), evaporate to dryness on a water-bath, *scrape* the dry residue out of the dish, reduce it to a fine powder, and again dry at 212° F. The weight of this residue should be 55 to 60 grains. The casein is to be calculated from the ammonia yielded by combustion of a portion of the dry residue with soda-lime, while the fat is estimated in another portion by extraction with ether, the ash ascertained in the remainder by combustion, and milk sugar estimated by difference.

Having found so much fault with Dr. Voelcker's lecture I cannot in justice omit to express my entire accordance with him in his remarks on those "chemists" who profess to determine the proportion of water to the second place of decimals, and who would make no allowance for the natural variations to which milk is undoubtedly subject.

Almost the only chemist who has published results in any way tending to corroborate those of Dr. Voelcker is Dr. Stevenson Macadam, who has given chemists the benefit of the results of an elaborate series of analyses of milk collected under the eyes of his own assistant. There appears to be no doubt of the genuine nature of the samples, and that they really represented the entire runnings of the cows; but, on the other hand, it must not be forgotten that the dealers had a direct and evident inducement, throughout the whole series of experiments, to reduce the quality of the milk to the lowest possible point, so that the results may be said to show the extreme limit to which it is possible to reduce the solids of milk. In fact, Dr. Macadam expressly states that an improvement in the food was followed by a corresponding improvement in the quality of the milk. Dr. Macadam's results, therefore, do not represent the average composition of milk, but the composition of milk taken under the most unfavourable conditions.

Under these circumstances, it is not surprising that Dr. Macadam obtained an average of only 7·8 per cent of cream, while even Dr. Voelcker admits 10 per cent to be a fair average. His "total solids" varied from 10·57 to 14·54 per cent, the average being 12·04 in 100 by weight of the milk.

The proportion of "solids not fat" found by Dr. Macadam varied from 8·74 to 11·23, with an average of 9·62 (!). In only three cases out of forty-four were the "solids not fat" below 9 per cent, the numbers in these cases being, respectively, 8·74, 8·85, and 8·94 in 100 by weight of the milk. The samples were not mixed, but represented the milk of individual cows.

Dr. Macadam estimated the fat by the *loss of weight* which ensued on treating the dry residue with ether. His results are much lower than those of most chemists, but, taken in conjunction with the low yield of cream, must be regarded as fairly representing the fat in the samples. His lowest result (1·56), however, is undoubtedly erroneous, as I shall be happy to show if desired.

According to the results of Dr. Campbell Brown, published in the Chemical News, vol. xxxi., p. 266, the poorest specimens of genuine milk out of upwards of three hundred samples contained fully 11 per cent of total solids, the three poorest samples yielding 8·81, 8·94, and 8·95, respectively, from 100 parts, by weight, of milk. These milks were taken under exceedingly disadvantageous circumstances, so that they may be considered as fairly representing the poorest genuine milk possible. Yet Dr. Voelcker's paper contains analyses of milk which show 9·3 and 9·7 of total solids, with 7·51 and 6·71 of "solids not fat."

Even with these disadvantageous figures, Dr. Voelcker's average results for the year (excluding the favourable month of August, of which we have no record) show the milk to have contained a mean amount of 9·18 of solids not fat, and 12·27 of total solids.

How, in the face of his own analyses, Dr. Voelcker could give the following reply before the Committee is for him to explain :—

"Question 5513.—What is the greatest variation in the milk solids which you have found?—The greatest variation which I have found is, in round numbers, from 10 to 14. In an exceptional case, perhaps, I may have found even more than 14, but it is quite an exceptional case; but, generally speaking, I should say the usual variations are from 10 to 12 in good wholesome milk.

It appears, therefore, that the proportion of "solids not fat" is almost invariably over 9 per cent, the few authenticated samples in which less than that amount has been found having been taken from individual cows under extremely disadvantageous circumstances, and even then the proportion was only a trifle under 9 per cent. The *limit* of solids not fat adopted by the Society of Public Analysts may therefore be taken as fairly representing the lowest quality of milk ever yielded by a dairy, though individual cows occasionally give a milk slightly under.

The average proportion of "solids not fat" is of course sensibly higher, and analysts would be likely to avoid annoyance if in future they would certify samples of milk as being adulterated with a certain quantity of water if originally of average quality, and so much less water if of the poorest quality. Thus, if in the case at Greenwich reported on page 7, in which the solids not fat amounted to only 7·92, Mr. Wigner had reported the milk to contain 15 per cent of added water if the milk were originally of average quality, and 12 per cent if of the poorest quality known, a conviction would doubtless have ensued, and the magistrate would have been convinced that the analyst had not lost sight of the natural variations in the composition of milk.

There is no doubt there has been a tendency to interpret the results of milk analyses too rigidly, and all of us must cordially acquiesce in Dr. Campbell Brown's recommendation to be guided by the special circumstances of each case, and rather allow some who add a small quantity of water to rich milk to go unpunished, than one innocent person to be unjustly fined.—I am, &c.,

Alfred H. Allen.

Sheffield, July 17, 1875.

NOTICES OF BOOKS.

On the Nature of the Elements of Chemistry. By J. A. Groshans. Harlem: Les Héritiers Loosjes.

From this work we extract the following passages :—

"C, H, and O appear to be the only simple bodies; each atom of these substances counts for a single unity; all the other elements count several unities in their atom. I have been able to extend my observations and my calculations to more than 20 elements besides C, H, and O. This is not the only point of view under which C, H, and O form a group distinct from the other elements; they are sometimes, conjointly with nitrogen, called the organic elements. M. Littré, in his work "La Science," observes that life does not belong indifferently to every kind of matter; but that it has a certain elective virtue, and that its relations are essentially with carbon, hydro-

gen, oxygen, and nitrogen. There would seem, then, to exist some link between nitrogen and C, H, and O. Without wishing to draw any premature conclusion, it may be permissible to observe simply that the atomic weight of nitrogen is 14, that it corresponds to three atoms, and that these same attributes are those of CH_2.

There was a time, we know, when eminent chemists were inclined to consider nitrogen as a compound body. At present, and for a considerable time, there has been a general return to the opinion that nitrogen should be regarded as a simple body by the same title as the other elements; however, as the real simplicity of these latter is now itself brought into question, it becomes necessary to revise the case of nitrogen.

It results, with complete evidence, from my observations and calculations, that nitrogen cannot be a simple body, but that it contains three atoms of simple bodies unknown. I purpose to demonstrate this double assertion by several independent methods."

Monthly Report of the Department of Agriculture for November and December, 1874. Washington: Government Printing Office.

THIS useful "blue book"—as we should call it in England—contains the statistics of the principal crops as produced in the United States, together with entomological, chemical, botanical, and microscopic memoranda of agricultural interest. Mr. McMurtrie, chemist to the department, has been investigating the application of arsenical compounds for the destruction of the Colorado beetle on potatoes. His experiments show that arsenic is not assimilated by vegetation. On this point—of considerable public importance, if we remember that the sulphuric acid used in manure-making contains arsenical compounds—his researches agree with those of Messrs. Ogston and Daubeny and clash with those of E. W. Davy. In many parts of the American Union the farmers suffer greatly from insect pests. As is the case in several European countries, the small insectivorous birds have been recklessly destroyed, a mistake which is bearing most unpleasant fruits.

Among the promiscuous paragraphs we find an "improvement" in the manufacture of cheese. The cream is removed from the milk, and oleo-margarine is added in its stead.

It appears that an attempt to introduce the cultivation of Upland cotton (Tennessee) in the province of Shantung, in China, has proved a failure. The pods never opened, and no fibre was obtained.

Outlines of Proximate Organic Analysis. By ALBERT B. PRESCOTT. New York: D. Van Nostrand.

PROXIMATE organic analysis may be described as a comparatively untrodden field. The best authorities at our disposal do little more than give us directions for detecting, isolating, and determining a few of the best-known organic acids and bases. But if it be desired to resolve an unknown body, animal or vegetable, into its immediate constituents, the operator has little to guide him save his own tact and experience. Under these circumstances we naturally welcome every chemist who attempts to supply so important a desideratum. Mr. Prescott arranges the substances of which he treats as solid fixed acids, solid volatile acids; liquid fixed acid; liquid volatile acids; fatty acids, liquid and solid; neutral substances; bases; glucosides; nitrogenous neutral bodies; carbohydrates and alcohols. Under each substance, he describes its characteristics, its separation from those bodies with which it is associated in nature, and, as far as known, its quantitative determination. From the table of contents we should judge that the author was more intent upon pharmaceutical than upon technological or physiological applications. The organic alkaloids and the essential oils are elaborated with remarkable care, whilst on the other hand the weed colours, hæmatoxilin, bresilin, carthamin, chlorophyll, &c., find no mention. The author, however, is far from professing to have furnished a complete and all-embracing system. He modestly admits that his work is "a fragmentary and very brief exponent of this part of analytical chemistry," and expresses the hope that "as a beginning, it may prove to be worth enough to afford an opportunity for its improvement hereafter." We trust that he will find ample opportunity to continue the important undertaking upon which he has entered.

CORRESPONDENCE.

ACTION OF THE GALVANIC CURRENT ON THE ORGANS OF SENSATION.

To the Editor of the Chemical News.

SIR,—It will give me pleasure to read Dr. T. L. Phipson's paper, when I can obtain the *Comptes Rendus*.

As, however, the independence of the galvanic taste and chemical action was not the "conclusion" drawn in my paper, but rather the minor premise, it is difficult to see how it can have been "anticipated."

I am glad to have Dr. Phipson's testimony to the fact.—I am, &c.,

W. H. STONE.

14, Dean's Yard, Westminster, S.W.,
July 19, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Justus Liebig's Annalen der Chemie, May 3, 1875.

Compounds of Thallium with Alcohol-Radicals.—Dr. F. Hartwig.—The author, after some general remarks on the difficulty of pointing out the true place of thallium among the chemical elements, describes thallium-diethyl-chloride, $Tl(C_2H_5)_2Cl$, thallium diethyl iodide, sulphate, phosphate, nitrate, and acetate of thallium-diethyl, hydroxide of thallium-diethyl, and certain unsuccessful attempts to prepare thallium triethyl.

Apparatus for the Absorption of Ammonia.—J. V.—This apparatus, for use in the determination of nitrogen by the method of Will and Varrentrapp, is so contrived that the titration can be performed in it, without pouring out the liquid into a beaker.

On Trimethyl-benzol.—Paul Jannasch.—The author describes the preparation of trimethyl benzol from crystalline bromxylol, from dibromtoluol, and its formation as a by-product during the conversion of dibromxylol into durol.

Communications from the Chemical Laboratory at Greifswald.—These consist of a memoir on orthotoluidin sulph-acid, by Dr. F. A. Pagel; a paper on the conversion of metabromortho sulphotoluolic acid into orthocresol sulph-acid; and an essay on the nitro diazo-compound of paramido-orthosulphotoluolic acid, by the same author.

Isonylamid.—H. A. Kullhem.—The author considers this body as an isomer of amid as prepared in the ordinary manner.

Oxidation of the Oxyacids of the Fatty Series.—W. Markownikoff.—Not adapted for abstraction

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Remarks on (a) the Symbol for the So-called Rotatory Power of Substances.—O. Hesse.—Reserved for insertion in full.

Further Remarks on the Javanese Cinchona Calisaya.—O. Hesse.—The author maintains, in opposition to de Vry, that the species cultivated in Java is not the true *C. Calisaya*.

Test for Sulphate of Conchinin.—O. Hesse.—Take 0·5 grm. of the sulphate in question (1 part), digest with 10 c.c. of warm water (20 parts), till the temperature of the mixture has risen to 60°. Then add 0·5 grm (1 part) of pure iodide of potassium, stir repeatedly, let cool, and filter after the lapse of an hour. If the preparation was pure the filtrate is not rendered turbid by the addition of a few drops of ammonia. If a precipitate appears in the filtrate, it may consist of quinin, cinchonidin, and cinchonin.

Test for Sulphate of Chinidin.—O. Hesse.—To detect the presence of cinchonin and conchinin, as well as of totally worthless bodies in the sample, take 1 grm. of the sulphate and cover it in a test-glass with 7 c.c. of a mixture of 2 vols. chloroform, and 1 vol. alcohol of 97 per cent by volume. If the salt is pure, a clear solution results, but if inorganic salts are present they remain undissolved. Further, take 0·5 grm. sulphate, and digest it witn 20 c.c. of water at 60°, and add 1·5 grm. salt of seignette, when a crystalline precipitate is formed. Filter after one hour and add a drop of ammonia to the filtrate. No turbidity should appear. If a precipitate is produced it may consist of cinchonin or conchinin.

Remarks on Dita Bark.—O. Hesse.—The author, in conjunction with Jul. Jobst, has been investigating this subject for some time, and has obtained several crystalline bodies, as well as traces of an amorphous alkaloid.

New Water Air-pump.—Arzberger and Zulkowsky.—This paper is useless without the accompanying illustration.

Improved Chloride of Calcium Tube.—This paper also requires an illustration.

On Amido Caprylic Acid.—E. Erlenmeyer and O. Sigel.—The authors describe the preparation of œnanthol and œnanthol-ammonia; the preparation, composition, and properties of amido caprylic acid and its salts, and speculate on its constitution.

Aniline Derivatives.—E. Mills.—The author suggests a procedure for the respective separation of the mono-, di-, and tri-derivatives of aniline which are formed in mixture.

Les Mondes, Revue Hebdomadaire des Sciences, No. 7, June 17, 1875.

Electric-Dynamic Machines.—A question of priority between M. Gramme and M. Lontin, into which the editor declines to enter.

Silvering Glass by means of Inverted Sugar, for Optical Purposes.—M. Adolphe Martin.—The author describes, at great length, certain improvements on his original process as given in *Les Mondes*, December 10, 1868.

Utilisation of Iron Pyrites.—It is well known that the sulphur necessary for the manufacture of sulphuric acid was formerly obtained from Sicily in the native state. The export duties having been considerably increased during the last 20 years the attempt was made to supersede it, and this was successfully accomplished by means of iron pyrites, a mineral which is met with in great abundance. The extraction of these pyrites is only profitable, however, where they occur in large masses. The residues of pyrites contain so large a proportion of iron (40 per cent) that in the single establishment of Meggen the loss thus occasioned amounts, annually, to more than a million and a quarter francs. These residues are, further, in such quantities that there is difficulty in finding room for them. Dr. Hofmann has succeeded in utilising them on the large scale by the following process. The residues undergo a systematic washing, the temperature of the water being about 40° C. To the washings thus obtained salt is added in the proportion of one equivalent for each equivalent of sulphuric acid present in the liquid. The result is sulphate of soda, which is separated by cooling and crystallisation. This product has numerous industrial applications, especially in the glass trade and in the soda manufacture, and it is obtained in the present case in quantity sufficient to cover the cost of all the operations. The mother-liquors remaining after the sulphate of soda has been separated contain zinc chloride, salt, sulphates of iron and of zinc, and a further quantity of sulphate of soda. By concentration to 54° B., the various salts are deposited, with the exception of the zinc chloride, which may then be separated. It has several industrial applications, and is sold in Germany at 18½ francs per 100 kilos., and is chiefly used for preserving railway sleepers. Or it may be worked for metallic zinc, by being first treated with lime to convert it into zinc oxide. The residue from the last operation still contains the iron originally present in the pyrites, as also some sulphur. It is dried for some days in the open air and the bulk of it crumbles to a powder, though there remain also compact fragments. Here is the most interesting phase of Dr. Hofmann's results on the pyrites of Meggen. It appears that the pulverulent portion is almost completely free from sulphur, while the fragments still retain considerable quantities. A simple process of sifting suffices to separate the part free from sulphur, which is then ready for metallurgical treatment as an iron ore.

Bulletin de la Societe Chimique de Paris, June 20, 1875.

Researches on Blood.—M. Armand Gautier.—A preliminary communication on the phenomena of coagulation. He remarks that the coagulation of blood is not the result of the life or the death of the blood. It depends neither on its carbonic acid nor on any of the gaseous elements, for the plasma may be dried and heated, even to 110°, without losing its property of spontaneous coagulability.

On Taurine.—M. R. Engel.—Taurine, generally regarded as isethionamid, is not, in reality, an amide, but a true glycocoll.

Action of Liquids, Culinary or Medicinal, upon Vessels of Tin Containing Lead.—M. Fordos.—An exhaustive enquiry into the circumstances under which lead in the form of plumbiferous tin used for lining saucepans, &c., and in the glaze of earthenware is attacked by wine, vinegar, solutions of common salt, &c. He concludes that lead in all forms should be excluded from cookery implements, and that its use should be prohibited under severe penalties.

Theory of Crystallisation and Solution.—M. Lecoq de Boisbaudran.—The author has recently announced that different isomorphs do not act in an identical manner upon a supersaturated solution, and that the different faces of one and the same crystal are not equally soluble. M. L. Pfaundler supposes that the fact of the unequal solubility of the surfaces of the same crystal may be explained by aid of the theory which he published some years ago, and that the author's results were indicated in such theory. M. L. de Boisbaudran, on the contrary, holds that the important hypotheses of M. Pfaundler are not merely not identical with the principles of which he has presented an experimental demonstration, but that they are incompatible with several of the facts observed. These hypotheses, which M. de Boisbaudran is far from wishing to reject as a whole, do not seem to him applicable to crystallisation or to solution. According to M. Pfaundler there must exist a continual exchange of molecules between a crystal and its mother-liquor. The exact point of saturation of the menstruum would correspond to the equality of the number of molecules

attaching themselves to the crystal in a given time, to the number of molecules, leaving the crystal and returning into solution. If we adopt this hypothesis, it is evident that even a very slight variation in the concentration of the liquid would alter the ratio between the numbers of molecules respectively entering and leaving the crystal, and would consequently induce an immediate increase or decrease of the weight of the crystal. This, however, does not take place, for a crystal, or a crystalline surface, may remain intact, without gain or loss in a liquid whose concentration varies within sensible limits. The author, therefore, concludes that the supposed exchange of molecules did not take place.

Central-Blatt fur Agrikultur Chemie,
Heft 4, April, 1875.

Determination of Ozone in the Air.—Prof. Pettenkofer and Dr. Wolffhügel.—Hitherto we were in want of a method for determining ozone in atmospheric air with even approximate accuracy, the methods in use being ozonoscopic rather than ozonometric. Pettenkofer points out as a great defect that in exposing ozone papers to the air, no attention is paid to the volume of air which sweeps over them in a given time. Wolffhügel found that 1000 litres of air, taken in the open air, produced a reaction with paper dipped in iodide of potassium and starch. But the air of houses, even from uninhabited and well ventilated rooms, produced no reaction even when 10,000 to 12,000 litres were passed over the paper. Ozone was also found wanting in subterranean air.

Composition of Drain Waters.—Prof. Aug. Voelcker. —Taken from the *Journal of the Royal Agricultural Society of England.*

Heat-Conductivity of Different Soils.—Dr. A. von Littrow.—The petrographic and chemical composition of a soil has little influence in comparison with its mechanical texture. Lime and magnesia seem to diminish the conductivity. In a moist state all soils conduct water better than when dry.

Power of Plants to Exhaust the Water of Soils. —Dr. R. Heinrich.—Plants differ in their power of utilising the water of the soil. In peaty soils barley withered when the soil contained 47·7 per cent of moisture, and rye at 53·4. In a lime soil maize faded at 8·6, and horse beans at 12·7 per cent. The hygroscopic moisture of soils does not appear available for the growth of plants.

Utility of Certain Trade Residues as Manures.— Dr. P. Wagner.—An account of certain kinds of refuse sold as manures, such as butchers' offal, glue-makers' waste, &c.

Manurial Value of the Fœcal Matter Obtained on Liernur's System.—Prof. W. Gintl.—The average proportions are given as—Water, 92·5; nitrogen, 0·771; total ash, 1·624; phosphoric acid, 0·270; potash, 0·144; and soda, 0·396 per cent.

Town Sewage as Nutriment for Crops.—Prof. A. Müller and Prof. Dunkelberg.—An abstract of a paper read before the Congress of Naturalists at Breslau. The authors remark, very justly, that in Germany irrigation would frequently be impracticable during the winter, and that the same applies to "intermittent filtration."

Formation of Urea in the Organism.—Dr. W. von Knieriem.

Amount of Soda, Potash, and Chlorine in Milk Compared with that in other Articles of Diet, and that of the Entire Mammalian Organism.—G. Bunge. —An examination of the ash of the milk of various animals, taken in connection with their diet.

Milk During the time of Heat and of Calving.— Dr. G. Schröder.—At the former period nothing abnormal was observed. The first milk after calving did not coagulate on boiling, and showed no colostrum globules.

Amount of the Pressure of Sap in Plants.—W. S. Clarke.—From the *Transactions of the Massachusetts Agricultural College.*

Evaporation of Water from the Oat under Different Circumstaeces of Heat, Light, and Atmospheric Moisture, and on its Need of Nitrogen.—Dr. J. Fittbogen.—Not suitable for abstraction.

Certain Chemical Changes During the Germination of Pumpkin Seeds.—Prof. N. Laskovsky.—The amounts of carbonic acid developed depend on temperature, on the amount of dry matter in the seed, and on the duration of the germination. Elevation of temperature increases the evolution of carbonic acid. There appears to be no constant ratio between the carbonic acid and the hydrogen developed. The fat that disappears is in constant proportion to the cellulose and carbonic acid formed.

Chemical Composition of the Principal Sorts of Grapes Cultivated in the Province of Rome.—F. Sestini and G. del Torre.

Amount of Sugar, Acid, Potash, and Phosphoric Acid in 1000 Grapes at Different Periods of Ripeness. Prof. C. Neubauer.

Investigation on the Nature of the Gelatinous Matter which separates from the Juice of Beet-Root.—Prof. C. Scheibler.—The chief constituent is dextran—a gum which turns the plane of polarisation to the right three times more powerfully than cane-sugar. Its formula is $C_6H_{10}O_5$.

Analyses of Samples of Wine.—Ch. Mène.—Taken from *Comptes Rendus*, vol. lxxix., No. 2, p. 136.

New Method of Producing Bread.—M. Cécil.— The author makes bread of the entire grain, after removal of the outer layer, and effects a saving of 30 per cent. He steeps the grain in water, when the skins are removed by revolving cylinders.

Causes of Alcoholic Fermentation.—Prof. Adolf Mayer.—The author maintains his former view that alcoholic fermentation is identical with the metastasis of the yeast-fungus.

Influence of the Access of Air on Alcoholic Fermentation.—Prof. Adolf Mayer.—The author finds that in the yeast plant the direct respiration of oxygen has no perceptible influence in splitting up sugar into the known products of fermentation.

Behaviour of Alcohol Yeast in Media Devoid of Oxygen.—Prof. M. Traube.—Taken from the *Berichte der Deutschen Chemischen Gesselschaft.*

Influence of the Addition of Alcohol to Must upon the Progress of Fermentation.—Dr. A. Blankenhorn.— Fermentation ceases if alcohol is added to the fermenting liquid to the extent of 14 to 15 per cent of its volume.

TO CORRESPONDENTS.

*** Vol. XXXI. of the Chemical News, containing a copious index, is now ready, price 12s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 2s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxxii. commenced on July 2nd, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

F.C.S.—We have made a careful reference, and find that Heft (January, 1875) of the *Central-Blatt fûr Agrikultur Chemie* contains all the articles named in the Chemical News for May 7, 1875. In Heft 1 there is no paper on the periodicity of hail.

Errata.—In the table, p. 26 of our last number, col. "Solids not Fat," line 2, *for* 10·34 *read* 10·32; line 6, *for* 8·88 *read* 8·94; line 13, *for* 9·98 *read* 9·08; line 14, *for* 8·56 *read* 8·59; line 15, *for* 8·10 *read* 8·06; *for* "The average of the whole of solids not fat is 9·18," *read* "is 9·15."

THE CHEMICAL NEWS.

Vol. XXXII. No. 818.

PRELIMINARY NOTICE OF

FURTHER RESEARCHES ON THE PHYSICAL PROPERTIES OF MATTER IN THE LIQUID AND GASEOUS STATES UNDER VARIED CONDITIONS OF PRESSURE AND TEMPERATURE.*

By Dr. ANDREWS, F.R.S.,
Vice-President of Queen's College, Belfast.

THE investigation to which this note refers has occupied me, with little intermission, since my former communication in 1869 to the Society, "On the Continuity of the Liquid and Gaseous States of Matter." It was undertaken chiefly to ascertain the modifications which the three great laws discovered respectively by Boyle, Gay-Lussac, and Dalton undergo when matter in the gaseous state is placed under physical conditions differing greatly from any hitherto within the reach of observation. It embraces a large number of experiments of precision, performed at different temperatures and at pressures ranging from 12 to nearly 300 atmospheres. The apparatus employed is, in all its essential parts, similar to that described in the paper referred to; and so perfectly did it act, that the readings of the cathetometer, at the highest pressures and temperatures employed, were made with the same ease and accuracy as if the object of the experiment had been merely to determine the tension of aqueous vapour in a barometer tube. In using it, the chief improvement I have made is in the method of ascertaining the original volumes of the gases before compression, which can now be known with much less labour and greater accuracy than by the method I formerly described. The lower ends of the glass tubes containing the gases dip into small mercurial reservoirs formed of thin glass tubes, which rest on ledges within the apparatus. This arrangement has prevented many failures in screwing up the apparatus, and has given more precision to the measurements. A great improvement has also been made in the method of preparing the leather-washers used in the packing for the fine screws, by means of which the pressure is obtained. It consists in saturating the leather with grease by heating it *in vacuo* under melted lard. In this way, the air enclosed within the pores of the leather is removed without the use of water, and a packing is obtained so perfect that it appears, as far as my experience goes, never to fail, provided it is used in a vessel filled with water. It is remarkable, however, that the same packing, when an apparatus specially constructed for the purpose of forged iron was filled with mercury, always yielded, even at a pressure of 40 atmospheres, in the course of a few days.

It is with regret that I am still obliged to give the pressures in atmospheres, as indicated by an air- or hydrogen-manometer, without attempting for the present to apply the corrections required to reduce them to true pressures. The only satisfactory method of obtaining these corrections would be to compare the indications of the manometer with those of a column of mercury of the requisite length; and this method, as is known, was employed by Arago and Dulong, and afterwards in his classical researches by Regnault, for pressures reaching nearly to 30 atmospheres. For this moderate pressure a column of mercury about 23 metres, or 75 feet, in length had to be employed. For pressures corresponding to 500 atmospheres, at which I have no difficulty in working with my apparatus, a mercurial column of the enormous height of 380 metres, or 1250 feet, would be required. Although the mechanical difficulties in the construction of a long tube for this purpose are, perhaps, not insuperable, it could only be mounted in front of some rare mountain escarpment, where it would be practically impossible to conduct a long series of delicate experiments. About three years ago I had the honour of submitting to the Council of the Society a proposal for constructing an apparatus which would have enabled any pressure to be measured by the successive additions of the pressure of a column of mercury of a fixed length; and working drawings of the apparatus were prepared by Mr. J. Cumine, whose services I am glad to have again this opportunity of acknowledging. An unexpected difficulty, however, arose in consequence of the packing of the screws (as I have already stated) not holding when the leather was in contact with mercury instead of water, and the apparatus was not constructed. For two years the problem appeared, if not theoretically, to be practically impossible of solution; but I am glad now to be able to announce to the Society that another method, simpler in principle and free from the objections to which I have referred, has lately suggested itself to me, by means of which it will, I fully expect, be possible to determine the rate of compressibility of hydrogen or other gas by direct reference to the weight of a liquid column, or rather of a number of liquid columns, up to pressures of 500 or even 1000 atmospheres. For the present it must be understood that, in stating the following results, the pressures in atmospheres are deduced from the apparent compressibility, in some cases of air, in others of hydrogen gas, contained in capillary glass tubes.

In this notice I will only refer to the results of experiments upon carbonic acid gas when alone or when mixed with nitrogen. It is with carbonic acid, indeed, that I have hitherto chiefly worked, as it is singularly well adapted for experiment; and the properties it exhibits will doubtless, in their main features, be found to represent those of other gaseous bodies at corresponding temperatures below and above their critical points.

Liquefaction of Carbonic Acid Gas.—The following results have been obtained from a number of very careful experiments, and give, it is believed, the pressures, as measured by an air-manometer, at which carbonic acid liquefies for the temperatures stated:—

Temperatures in Centigrade Degrees.	Pressure in Atmospheres.
0·00	35·04
5·45	40·44
11·45	47·04
16·92	53·77
22·22	61·13
25·39	65·78
28·30	70·39

I have been gratified to find that the two results (for 13·09° and 21·46°) recorded in my former paper are in close agreement with these later experiments. On the other hand, the pressures I have found are lower than those given by Regnault as the result of his elaborate investigation (*Mémoires de l'Académie des Sciences*, vol. xxvi., p. 618). The method employed by that distinguished physicist was not, however, fitted to give accurately the pressures at which carbonic acid gas liquefies. It gave, indeed, the pressures exercised by the liquid when contained in large quantity in a Thilorier's reservoir; but these pressures are always considerably in excess of the true pressures, in consequence of the unavoidable presence of a small quantity of compressed air, although the greatest precautions may have been taken in filling the apparatus. Even $\frac{1}{100}$th part of air will exercise a serious disturbing influence when the reservoir contains a notable quantity of liquid.

Law of Boyle.—The large deviations in the case of carbonic acid at high pressures from this law appeared distinctly from several of the results given in my former paper. I have now finished a long series of experiments on its compressibility at the respective temperatures of 6·7°, 63·7°, and 100° C. The two latter temperatures were obtained by passing the vapours of pyroxylic spirit (methyl-alcohol) and of water into the rectangular case with plate-glass sides, in which the tube containing the carbonic acid is

* A Paper read before the Royal Society.

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placed. The temperature of the vapour of the pyroxylic spirit was observed by an accurate thermometer, whose indications were corrected for the unequal expansion of the mercury: while that of the vapour of water was deduced from the pressure as given by the height of the barometer and a water-gauge attached to the apparatus. At the lower temperature (6·7°), the range of pressure which could be applied was limited by the occurrence of liquefaction; but at the higher temperatures, which were considerably above the critical point of carbonic acid, there was no limit of this kind, and the pressures were carried as far as 223 atmospheres. I have only given a few of the results; but they will be sufficient to show the general effects of the pressure. In the following tables p designates the pressure in atmospheres as given by the air-manometer, t' the temperature of the carbonic acid, ϵ the ratio of the volume of the carbonic acid under one atmosphere and at the temperature t' to its volume under the pressure p' and at the same temperature, and θ the volume to which one volume of carbonic acid gas measured at 0° and 760 millimetres is reduced at the pressure p and temperature t':—

Carbonic Acid at 6·7°.

p. Atmospheres.	t'. Degrees.	ϵ.	θ.
13·22	6·90	$\frac{1}{14·36}$	0·07143
20·10	6·79	$\frac{1}{23·01}$	0·04456
24·81	6·73	$\frac{1}{29·60}$	0·03462
31·06	6·62	$\frac{1}{39·57}$	0·02589
40·11	6·59	$\frac{1}{58·40}$	0·01754

Carbonic Acid at 63·7°.

p. Atmospheres.	t'. Degrees.	ϵ.	θ.
16·96	63·97	$\frac{1}{17·85}$	0·06931
54·33	63·57	$\frac{1}{66·06}$	0·01871
106·88	63·75	$\frac{1}{185·90}$	0·00665
145·54	63·70	$\frac{1}{327·30}$	0·00378
222·92	63·82	$\frac{1}{446·90}$	0·00277

Carbonic Acid at 100°.

p. Atmospheres.	t'. Degrees.	ϵ.	θ.
16·80	100·38	$\frac{1}{17·33}$	0·07914
53·81	100·33	$\frac{1}{60·22}$	0·02278
105·69	100·37	$\frac{1}{137·10}$	0·01001
145·44	99·46	$\frac{1}{218·90}$	0·00625
223·57	99·44	$\frac{1}{380·90}$	0·00359

These results fully confirm the conclusions which I formerly deduced from the behaviour of carbonic acid at 48°, viz., that while the curve representing its volume under different pressures approximates more nearly to that of a perfect gas as the temperature is higher, the contraction is nevertheless greater than it would be if the law of Boyle held good, at least for any temperature at which experiments have yet been made. From the foregoing experiments it appears that at 63·7° carbonic acid gas, under a pressure of 223 atmospheres, is reduced to $\frac{1}{380}$th of its volume under one atmosphere, or to less than one-half the volume it ought to occupy if it were a perfect gas and contracted in conformity with Boyle's law. Even at 100° the contraction under the same pressure amounts to $\frac{1}{380}$ part of the whole. From these observations we may infer, by analogy, that the critical points of the greater number of the gases not hitherto liquefied are probably far below the lowest temperatures hitherto attained, and that they are not likely to be seen, either as liquids or solids, till much lower temperatures even than those produced by liquid nitrous oxide are reached.

(To be continued).

ON THE USE OF

POTASSIUM FERRO- AND FERRI-CYANIDE FOR THE DETECTION OF NICKEL AND COBALT.

By R. H. DAVIES, F.C.S,

Demonstrator of Chemistry in the Laboratory of the Pharmaceutical Society.

In a former number of the Chemical News (vol. xxiii., p. 290) Mr. Allen has advocated the employment of ferricyanide of potassium for the above purpose, and has detailed the method he adopts for the qualitative analysis of solutions which might contain nickel and cobalt.

Briefly, the method is as follows:—Ferricyanide of potassium is added to the solution, which has previously been treated with ammonium chloride and ammonia in excess. A red colouration indicates cobalt. Upon then boiling this liquid, a copper-coloured precipitate is deposited, which contains the nickel.

No objection can be urged against this process, except that, if the amount of nickel present be very small, a precipitate is only obtained after boiling the liquid for some minutes.

By using ferrocyanide of potassium after the addition of ferricyanide, this is rendered unnecessary, and I should propose the following as a modification of the above test. When only the two metals, nickel and cobalt, are present in solution, add ammonia until the precipitated hydrates are re-dissolved (ammonium chloride does not appear to be essential), then potassium ferricyanide. If the amount of cobalt is large, a reddish brown precipitate of cobalt ferricyanide will occur. This is soluble in excess of the ferricyanide solution, which must then be added until it has disappeared, and a deep red-brown liquid results. It is, perhaps, hardly necessary to state that, if only an exceedingly small quantity of cobalt be present, no precipitate, but a colouration merely (in itself evidence of this metal), will be observed upon the addition of ferricyanide. Ferrocyanide of potassium must now be added, and here, again, a precipitate of nickel ferrocyanide will occur if much nickel salt be present. If the liquid remain clear, add hydrochloric acid drop by drop, noting the effect. A precipitate (yellowish white) upon the addition of from 6 to 12 drops, while the colour due to cobalt ferricyanide remains unchanged and the liquid is still strongly alkaline, indicates nickel, whilst if none of this element be present no apparent effect will be produced by the hydrochloric acid, until suddenly, on neutralisation, the colour disappears, and a yellowish white precipitate of cobalt ferrocyanide is thrown down.

I regret that I have not yet succeeded in utilising this reaction for quantitative work. Whenever cobalt is present as well as nickel, the precipitate at first obtained (which I judge to be nickel ferrocyanide) contains some cobalt, and the amount of the latter appears to vary with the varying proportions of the mixture.

I have lately been trying the effect of omitting the ferricyanide altogether, and employing ferrocyanide to indicate both metals. When this reagent is added to a dilute solution of cobalt salt in ammonia, the light yellowish liquid changes rapidly with heat, more slowly at ordinary

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temperatures, and assumes a colour very similar to that obtained immediately upon adding ferricyanide of potassium to a solution of the same strength. If hydrochloric acid be now added, the same result will be obtained as in the former instance; very little effect, apparently, before neutralisation if cobalt only is present; a precipitate long before neutralisation if nickel accompanies cobalt.

There seems little to choose between the two methods. On the score of accuracy, either leaves very little to be desired; perhaps, for expedition's sake, the latter is preferable.

Mr. Skey has told us that, by using ferricyanide of potassium, 1 part of cobalt in 60,000 of water may be easily detected. I have detected 1 part of nickel in 10,000 of water by the former of the two processes, in which ferrocyanide is used.

When ferrocyanide of potassium is added to a solution of nickel salt, so diluted that the amount of ferrocyanide of nickel formed does not render the liquid perceptibly turbid, upon boiling the liquid assumes a light clear green tint, very easily observed by looking through the bulk of liquid, as in the operation of Nesslerising. This colour differs very much from the yellowish colour obtained upon boiling a test-tube full of water, to which two or three drops of solution of potassium ferrocyanide have been added, and from any tint that I have been able to get with mixtures of ferrocyanide with very dilute ferric and ferrous solutions; and it is even more evident after the nickel compound has been freed as far as possible from impurities. I am inclined to attribute it to the nickel salt itself, a conclusion I have been some time in arriving at.

One part of nickel salt in 100,000 yields a distinctly green solution upon boiling after adding a drop or two of ferrocyanide of potassium.

In conclusion, the main object of this paper is to show that—(1) Since ferrocyanides of Co and Ni are both soluble in liquids strongly alkaline with ammonia; and (2) since the solubility of the former salt in liquids not so strongly alkaline is greater than that of the latter,—we have a means of approximately separating the two metals, sufficient for qualitative analysis, by the gradual addition of acid to the solution of their ferrocyanides in ammonia.

I have to thank Mr. W. M. Paterson for the aid he has so kindly afforded me in working out some of the details for the most advantageous application of the test.

17, Bloomsbury Square, W.C.

IMPLEMENTS FOR FILTRATION.*

By P. CASAMAJOR.

(Concluded from page 34).

II.—*New Funnels for Filtering under Pressure.*

Although the advantages resulting from the use of filter-pumps are obvious, these useful implements are comparatively little used. This circumstance cannot be attributed wholly to the difficulty or expense attending their construction, for many laboratories are provided with them in which they remain idle because operators prefer to work without them. The chief objection to their use is that, if any portion of a paper filter is not properly supported, it will be inevitably torn as soon as a vacuum is formed under it. This accident happens so often that most chemists are unwilling to risk the loss of an analysis for the sake of saving time in filtering.

The plan generally adopted for preventing the tearing of filters is to use a perforated cone made of platinum-foil, which is placed so as to support the apex of the paper filter. For the sake of greater safety, instead of a single filter, two are used, one lying within the other. The portion of the filters above the platinum cone is pressed tightly against the sides of the funnel. This is the plan of Prof. Bunsen. It generally gives satisfactory results when great care is taken; but sometimes, even after giving the greatest attention to the security of the paper filter, it becomes torn and the precipitate goes through. Often, when the liquid has passed through clear, have I found part of the precipitate between the inner and outer filter.

After trying many ways of overcoming this difficulty, I was fortunate enough to find a plan which answers so perfectly that I am able to say that torn filters and lost precipitates are things that trouble me no more. It is my purpose to describe this plan here, and, as it was suggested to me by a process of filtration published by Dr. H. Carmichael,* I propose to give a brief account of Dr. Carmichael's process, and afterwards to give a description of my plan.

In the process proposed by Dr. Carmichael, which may be designated *upward filtration*, a liquid holding a precipitate in suspension, instead of being filtered by placing it in a paper cone held in a conical glass funnel, is poured into a platinum dish, and the liquid is separated from the precipitate by the agency of a small paper disk held against a perforated surface belonging to a vessel the interior of which communicates with an aspirator. While one side of the paper disk adheres to the perforated surface, the other side is in contact with the contents of the platinum dish, so that when the pressure is reduced in the vessel the liquid passes through the paper, leaving the precipitate in the dish.

In Dr. Carmichael's arrangement the vessel is a bulb blown at the end of a glass tube, and the surface against which the paper adheres is a part of the bulb which has been flattened and riddled with holes.

This arrangement solves completely the problem of supporting the whole surface of the paper filter, as this is a flat disk resting on a flat perforated surface. There is, however, a serious drawback to using this arrangement, which is that the construction of its most important element is—to say the least—a very difficult matter. To obtain the perforated surface the following directions are given in Crookes's "Select Methods of Chemical Analysis," p. 431:—"Take a glass tube having an inner bore of 2 m.m.; blow at one end a thick bulb; flatten the bulb at the bottom; keep this bulb so hot that the glass is only slightly softened, and, while in this condition, make holes in it by means of a white-hot steel wire."

After trying several plans to accomplish the same result in a more satisfactory manner, I had the good fortune to find the following solution:—It consists in the simple expedient of supporting the circular paper filter by a thin perforated metallic disc, applied to the inside of the funnel. The filter is to be made somewhat larger than the metallic disc, so that its edges may rest on the funnel; and the funnel itself must have such a shape that the angle between the metallic plate and the funnel be very obtuse (about 165°). The deformation of the paper filter in that case is not perceptible; but if the angle should be too small the edges of the paper filter will not lie flat on the funnel, and it will not be possible to have a tight joint.

In Figs. 3 and 4 are represented the funnels I have adopted: in Fig. 3 is represented the funnel for filtering in the manner recommended by Dr. Carmichael; and in Fig. 4 the one for ordinary downward filtration, which form I use most frequently. With this funnel satisfactory results may be obtained even without a filter-pump, as will be presently shown.

The funnel represented in Fig. 3 resembles somewhat a Plattnerian blowpipe mouth-piece. To make use of it we lay one or two circular paper filters on a perforated metallic disc, having a somewhat smaller diameter. If now the funnel is placed in communication with the vacuum formed by a filter-pump, and the paper filter is moistened, it will adhere to the funnel when applied against its interior surface. In applying the filter and

* Communicated by the Author.

* See "Select Methods of Chemical Analysis," by William Crookes, F.R.S., p. 429.

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metallic disc care should be taken that the disk be placed inside and the filter outward. I have sought to indicate the metallic disc by a line of coarse dots, while the paper filter is represented by a fine dotted line. Platinum is the best material for making the perforated discs, which may

Fig. 3

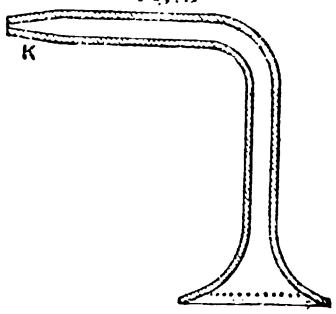
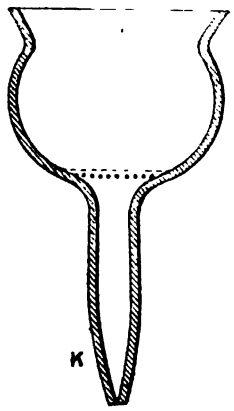


Fig. 4.



be easily riddled with holes with a coarse needle. For many purposes perforated tin plate and brass answer very well. As to their sizes, I may say that those I use have diameters of 1 inch to 1¼. The paper filters are ¼ inch larger. With these small surfaces the results obtained are much superior to those given by conical filters made from discs of 6 inches diameter.

After a precipitate has been thoroughly drained and washed, it may be allowed to dry by continuing the action of the filter-pump for some time. After stopping the action of the filter-pump, if the funnel be slightly shaken, the paper filter and perforated metal plate will remain in the platinum dish, while a small portion of the precipitate will still adhere to the funnel. The metallic disc, lying on top of the precipitate in the dish, is very easily removed by forceps. To remove the small portion of precipitate adhering to the funnel, it should be dried by placing the funnel in a porcelain dish and heating slightly. When dry it may be entirely removed from the funnel with a feather, and added to the contents of the platinum dish.

With some precipitates there exists a remarkable peculiarity, to which it is not useless to call attention to show how the trouble caused by it may be avoided. An instance of a substance showing the peculiarity in question is the fine powder obtained when bone-black has been treated with hydrochloric acid so as to dissolve the calcic salts. If this fine carbon and the liquid accompanying it are thrown in the platinum dish, the liquid will be taken up by the aspirator as long as enough water remains with the finely divided carbon. When most of the water has been separated the carbon becomes quite firm, and adheres like a cement to the filter, so that no amount of suction can free the tube *k* from the water it holds. The tube may be drained, however, by inserting a very fine needle under the paper disk after the precipitate has become quite firm: this opens a small air-passage, and the liquid in the tube is immediately aspirated.

Funnel for Filtering Downwards.—This funnel is represented in Fig. 4. The metallic disc is represented by a line of coarse dots, while the paper filter is shown by a fine dotted line. The shape of the funnel, in the portion near the filter, is the only essential part. The general form of it has been adopted for the greater convenience of the glass-blower. The end *k* is made tapering, so as to connect and disconnect with the aspirator by insertion in a rubber tube. The filtering disc is placed in this funnel as in the one represented in Fig. 3. If two superposed filters are used instead of a single thickness the filtration will be quite as rapid, while the safety will be greater. Before pouring the liquid in the funnel it is always advisable, for greater safety, to press down the margin of the filter, so as to insure the closing up of any minute opening left by a fold in the paper. This recommendation applies equally to filters used with the funnel represented in Fig. 3.

The funnel represented in Fig. 4 may be used advantageously without the filter-pump, by attaching to the end *k* a vertical glass tube of small diameter. The contraction at the end *k* in this case becomes very useful, by allowing the filtered solution to collect before descending in the vertical tube so as to fill the tube. In this manner there is formed a vertical column which creates an aspiration, and gives quicker filtration than can be had with a common conical funnel. The washing of the precipitate is also more thorough, because all the water placed in the funnel has to go through the precipitate, while in the ordinary conical funnel a part passes off above the precipitate. For the same reason it is obvious that this funnel may be used as a percolator to exhaust porous materials of their soluble parts. The additional length obtained by connecting with a vertical tube would not be of any utility with a conical funnel, unless a platinum cone was used to support the apex of the filter, and at the same time the rest of its surface was pressed down tightly on the glass; otherwise the air, entering freely around the filter, would not allow a column of liquid to form and to produce suction.

With the funnel represented in Fig. 4 very good results are obtained with tubes only 15 inches long. Longer tubes act with greater energy, but are inconvenient to use.

471, Lafayette Avenue, Brooklyn, N.Y.,
May 6, 1875.

NOTE ON SALICYLIC ACID.

By EDWARD R. SQUIBB, M.D., Brooklyn, N.Y.

THIS substance, long known as a rare and curious chemical derived from the vegetable kingdom, has lately been brought into prominent notice, chiefly in Germany, from its relation to those changes which are commonly known, and best understood as fermentations, to which class or kind of changes so many diseases and pathological conditions are now pretty well known to belong.

The writer knows far too little of the subject and its relations to attempt an accurate or exhaustive paper upon it, and the object of this note is simply to call attention to it, that it may be read up in the current literature—to give a brief outline of its bibliography, that reference may be made in regard to its history—and to offer some thoughts in regard to its sphere in medicine.

Salicin is a glucoside, or neutral vegetable principle

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discovered by Leroux* in 1830, in the bark of some species of willow, *Salix*, whence its name. It was afterwards found in various species of poplar,† and in other trees and plants. Salicin was chiefly investigated by Piria‡ who gave an elaborate account of its derivatives, and among these, of salicylic acid. Early in its history the acid was prepared by Löwig and Weidmann§ from the flowers of *Spiræa ulmaria*; and later, a research by Prof. Procter,‖ of Philadelphia, showed that our oil of wintergreen, *Gaultheria procumbens*, was really a salicylous ether; and from this source salicylic acid was obtained by Cahours.¶ Gerhardt,** Ettling,†† and others contributed to the researches by which the properties and reactions of salicylic acid were accurately determined and its composition fixed; but as yet it was but a chemical curiosity whose potential possibilities were quite unknown. It still belonged to that class of substances which had simply consumed a large amount of patient labour, and in relation to which the rigid utilitarian asked Michael Faraday "What is the use of such things?" and received for reply the answer, "What is the use of a baby?"

The physiological and pathological effects of salicin though imperfectly investigated, seem to have gradually and slowly directed attention to those of its derivatives, and occasional paragraphs have appeared in current scientific literature, from time to time, upon salicylic acid for some years past. But only within a year or two —and the writer regrets that he does not know by whom first—German writers have alluded to its peculiar and powerful effects as an antiferment, and antiseptic. As its peculiar powers were recognised, and its importance became possible and probable, the sources from which it had been obtained as a chemical curiosity became impracticable, in consequence of the small quantity which could be obtained from them, and the great cost in material and labour.

The next step in the progress of salicylic acid toward practical utility affords an excellent illustration of the progress in chemical knowledge made of late years.

The modern chemist appears to know, within certain limits, the combinations of the elements in organic substances very much as he knows the axes of crystals, and hence deduces their planes of cleavage. That is he knows how they will split up under given conditions, and what new arrangements of their elements are possible, or even practicable. And further, he knows by pure reasoning upon facts, what new elements to introduce between the molecules of one combination to split it up by a new set of affinities into new combinations never before seen or reached, and which would have remained long unknown under the mere empirical researches of the older chemistry. The peculiar properties and reactions of salicylic acid as an antiferment producing a demand for it, the German chemists, Kolbe†† and Lautemann, sought for an organic compound which from its elementary composition might be split or dissociated into the desired new compound salicylic acid. This substance, whose molecule might be broken up, they found in phenol, or the so-called carbolic acid, and it is a very curious circumstance—purely accidental so far as this writer knows—that a substance of well and long established character as an antiferment, should have offered to these chemists a molecular constitution so well adapted to be broken up into a still more powerful antiferment; for there is no relation whatever, either in composition, or chemical, or physical properties between carbolic acid and salicylic acid, except in their effects as antiferments, and the two may, so far as present knowledge extends, accomplish these effects by similar, or by altogether different reactions. The agent which the German chemists selected to resolve the molecule of phenol into other molecules, one of which should be salicylic acid, was dry carbonic acid or carbonic anhydride, as it is called in the new chemistry. Thus from the action of carbonic acid on carbolic acid, salicylic acid is produced; a process which is about as far from the original willow tree as a source of the acid as can well be imagined, and yet a process which is as much the result of human knowledge based upon human research as that by which Le Verrier and Adams discovered the planet Neptune. It appears that where phenol or cresol, and perhaps others of the class of phenols, are combined with an alkali metal such as sodium or potassium, thus forming phenol-sodium (often called phenate of soda) for example, and well dried carbonic anhydride is passed through the dry powder of phenol-sodium heated to 100° to 250° C.=212° to 482° F., the reaction occurs which produces salicylate of sodium and other compounds. The salicylate of sodium thus formed is dissolved in water and decomposed by hydrochloric acid, which, uniting with the sodium by superior affinity, sets free the salicylic acid in the form of small crystals. These crystals are washed and re-crystallised from a hot solution, and when dried form a crystalline powder of a light brown colour, somewhat resembling in colour the powder of pale cinchona bark. This is unbleached salicylic acid, and is probably pure enough for almost all, if not for all, the purposes to which the acid is at present applied to practical uses. The small proportion of colouring matter which it contains in this condition is held by it with great tenacity, and the further processes by which it may be obtained of various shades up to whiteness are so difficult, troublesome, and expensive, that they more than double the cost of production. This bleaching may be accomplished in various ways to a certain extent, but to get the acid quite white, Kolbe recommends that it be converted into an ether, and this ether be again decomposed. In the writer's practice no good plan of decolourising has yet been reached, and as the decolourising has not yet been shown to be necessary or very useful, no great attention has yet been given to it. The acid imported from Germany at very high prices is occasionally quite white; but most of that sold at the more moderate prices of 2 to 3 dollars per ounce is of various degrees of whiteness, up to a very light cream colour with a reddish tinge. These varying shades of colour seem to show that bleaching processes, more or less effective, have been used with all the acid yet imported into this country; while, so far as known, none has been made here until the writer lately undertook it. Hence the entirely natural, or entirely unbleached acid has not, so far as known, been yet used to any considerable extent; and it is a mere reasoning process based upon the quantity and qualities of the colouring matter in the well-made unbleached acid by which it is inferred that for most, if not for all of its present uses, this is as good as the more or less bleached product. If the well-made unbleached acid be found to subserve all the useful purposes to which the substance may be applicable, as is confidently expected by this writer; and if the substance should even in moderate degree realise the expectations of its importance in the arts, and in medicine, as indicated by the European authorities, the process of Kolbe will make it practically attainable in the necessary quantities at a far lower cost; whilst without some such process it would be of very limited use to mankind, whatever might be its powers. Whether bleached or unbleached, the acid is in minute broken acicular crystals, which give it the appearance of a granular powder, soft and smooth under the pestle or knife, but somewhat rough or resinous when rubbed between the fingers. This powder is odour-

* *Journ. de Chim. Med.*, vol. vi., p. 341.
† Braconnot, *Ann. Chim. Phys.*, vol. xliv., p. 296.
‡ Piria, 1, *Compt. Rend.*, vol. vi., p. 388, and *Ann. Pharm.*, vol. xxx., p. 165.
§ *Journ. Pr. Chem.*, Bd. xix., s. 236.
‖ *Amer. Journ. Pharm.*, vol. xiv., p. 211.
¶ *Compt. Rend.*, vol. xvi., p. 863.
** *N. Ann. Chim. Phys.*, vol. vii., p. 217.
†† *Ann. Pharm.*, vol. lxiii., p. 77.
‡‡ *Archiv. der Pharmacie* (3) vol. v., p. 445, from *Journ. fur Practische Chemie*, Bd. x., s. 89, and quoted in *Ding. Polyt. Journ.*, Bd. ccxiv., s. 132, and in *Pharm. Journ.*, third series, No. 231.

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ess and nearly tasteless. It has, however, a sweetish and astringent after-taste with slight acridity in the fauces, but none in the mouth; and though tasteless, it leaves a disposition or inclination to expectorate, which continues for some time.

It is practically insoluble in cold water, but is very soluble in hot water; and the water of a hot solution retains when cold, in proportion to its coldness, from about 1 part in 250, to 1 part in 500 of the solution. The presence of various neutral salts in small proportion in the water render it far more soluble. Up to this time phosphate of sodium seems to have been chiefly used in Germany* to render it more soluble in water for medicinal purposes, and it is said that 3 parts of phosphate of sodium will render 1 part of the acid easily soluble in 50 parts of water. It is much more soluble in alcohol and ether than in water. It melts at about 125° C. = 257° F., and sublimes at about 200° C. = 392° F.† In common with other similar acids it forms salts with the principal bases, but these seem thus far to be difficult to make, and their effects have not been investigated.

It is used for medical and surgical purposes either dry or in solution. When used dry it is sprinkled on to wounds, ulcers, or dressings in the form of very fine powder, in very small quantities, either simply powdered, or mixed in various proportions with some diluent, such as starch. When used in simple solution either for spraying surfaces, or for washes or gargles, it is used in tepid solution of about 1 part to 300 parts of water. Where stronger solutions are required for washes, gargles, or to moisten dressings, 1 part of the acid and 3 parts of phosphate of sodium to 50 parts of water have been used. When applied to wounds it appears immediately in the urine.‡

Its alleged advantages over all other antiseptics are: First, that it is far more powerful and effective in smaller quantities; and secondly, that it is, in all quantities necessary for complete effectiveness, entirely devoid of irritant action upon the living tissues. It is not caustic nor corrosive in any quantity, and never produces inflammation. In large quantities it may be irritant and painful, but yet rarely surpasses a stimulant effect, while it appears to be quite neutral in the very small quantities which are yet thoroughly effective; thirdly, it is said to reach and prevent processes of decomposition which are beyond the reach of all other antiseptics or antiferments. These processes are of two kinds, namely—vital, or those in which living organisms have an important part, such as that produced by yeast and many of those which occur in putrefaction; and chemical, or those which occur independent of vitality, as the production of the volatile oils in mustard and bitter almonds, the effect of diastase, &c. Now, while carbolic acid and other anti-ferments are azymotic, or completely arrest or prevent fermentations of the first kind, they are powerless with the chemical processes. Salicylic acid is said to be more effective with the vital ferments, and equally effective with the chemical.

Fourthly, in quantities said to be thoroughly effective, it is entirely odourless and tasteless, and harmless, whilst it has no poisonous effect in any reasonable quantity.

It prevents or arrests the souring of worts, washes, and beers of the brewers, and prevents or arrests the putrefactive agencies which are so troublesome and destructive to the glue manufacturers; and these and similar trades have thus far seemed to be its principal consumers. Separate portions of fresh milk set aside to become sour, one to which 0·04 per cent of salicylic acid was added, soured thirty-six hours later than the other. Urine thus protected was on the third day still clear, and free from ammoniacal odour.

Varying proportions of the acid added to accurately measured separate portions of sweet milk, and these carefully observed afterward until they sour—or, by the use of meat juice instead of milk, observed closely for signs of putrefaction—would offer good indications of the quantities required to arrest these varieties of fermentation.

Professor Thiersch, of Leipsic,* used it upon contused and incised wounds, and in operations, with excellent general results, destroying the fetid odour of cancerous surfaces and pyæmic ulcerations. To such uses this writer would add the suggestion that for washing out the cavities of the abdomen and chest after those operations which tend so strongly to septicæmia, solutions of salicylic acid would seem to offer very great advantages should it prove to be as bland and unirritating as it is stated to be, and yet so effective.

Most of these statements are summed up from the periodical literature of continental Europe during the past six months, little having appeared upon the subject in Great Britain, or in this country, and nothing having been done with it so far as known in either country.

In occasional paragraphs and allusions benzoic acid has been coupled with salicylic acid as being only second to it in effectiveness as an anti-ferment, and with similar advantages.

These statements are collated and condensed here as being well worth attention in themselves, and in their relations to the phenomena of septic poisoning as already known. But they have a new significance, or at least suggest to this writer a new train of thought when viewed in connection with some researches now in progress and but just appearing in the periodical literature.

Experiments† were made upon animals by the injection of measured quantities of septic blood. The blood of a healthy animal was allowed to become putrid. Increasing doses of this were injected into healthy animals until the amount necessary to cause death was ascertained. This quantity proved to be large, the animals recovering from all the small doses. Blood from the animal whose death was caused by injections of putrid blood was injected in increasing doses into healthy animals until the fatal dose was reached, and this dose was found to be smaller than that which killed the first animal. The blood of the second dead animal was used on healthy subjects in the same way as that of the first, and proved fatal in still smaller quantity. The experiments were continued upon the same plan until finally a point was reached when a very minute portion—the fraction of a drop perhaps—from the last animal proved fatal to the next, with more violent toxic symptoms and a shorter course. The important indications of this series of experiments is of course the rapid accumulation of potency in septic poisoning. And the question put by this indication is not only as to how this potency accumulates, but also how to prevent and arrest it. Metroperitonitis and common pyæmia would, doubtless, unobstructed, accumulate potency in the same way without visible inoculation, and often do continue and accumulate even against the vigorous application of the best means of prevention yet known. No hypothesis can be constructed that will embrace the phenomena of septic poisoning, as they are now rapidly being investigated without including zymotic diseases and the cachexiæ, and none will account for the phenomena already observed without bringing it within the sphere of what is called, in some of its degrees or phases, fermentation. Hence, if the medical art is to keep pace with the progress of the physical sciences, physicians cannot afford to pass by such articles as salicylic and benzoic acids when offered by chemistry, without investigating their effects upon disease, even though not one out of ten should repay the labour of investigation, for it is certainly in this

* Thiersch, *Pharm. Centralhalle*, Oct 22, Nov. 5.
† Watts's "Chem. Dictionary," Art. "Salicylic Acid."
‡ Thiersch, as above cited.

* *Pharm. Centralhalle*, Nos. 44 and 45, 1874.
† Bergman, Panum, Davaine, Vulpian, and Bouley—the latter researches in *Bulletins de l'Acad. de Med.*, 1872. 1873, and Davaine, translated by Mary C. Putnam, M.D., in *Archives of Scientific and Practical Medicine*, by C. E. Brown-Sequard and E. C. Seguin, No. 5, p. 469.

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direction of research that medicine must look with greatest hope of success to control those abnormal vital processes which so far may be modified, but not stopped. For example: Suppose a primary syphilitic or cancerous sore, or a diphtheritic patch, or even a cachectic pulmonary infection, while these are merely the localised phenomena of an external inoculation, or of an internal taint,—they must all be considered to partake of the nature of a fermentation, and by some such process invade the whole organism. Then suppose an anti-ferment, which when applied to any surface not covered by an impervious cuticle very soon appears unchanged, first in the blood, and then in the secretions and excretions,—the manifest logical antagonism of such substance to the diseased conditions becomes too important to be neglected, and the counsels of wisdom demand that its claims to such antagonism be disproved before it be dismissed. The question as to what may become of the cancer-cell, or of the less tangible precedent cause of it, or of the bacteria, or the precedent conditions which increase their fertility, under the well-directed influence of this class of agents, is, perhaps, the most important one in all medical science. And just in proportion as accurate research develops agents of greater and greater power, will be the prospect of better success in treatment.

The phenols, especially the so-called carbolic and cresylic acids (phenol and cresol), were, and must always remain to be, most important additions to this class of agents, surpassing in power all that had been previously tried. And if now salicylic acid shall prove more potent than the phenols the further gain will be very great, and the researches upon it will again lead up toward future discoveries of still greater power.

SOCIETY OF PUBLIC ANALYSTS.

THE MILK QUESTION.

To the Editor of the Chemical News.

SIR,—Mr. Allen has done good service by calling attention to the method of milk analysis recommended by Dr. Voelcker. I may add that the work in which it appears bears the date February, 1875, and that there is ample internal evidence that it is the method adopted by Dr. Voelcker in making the analyses of milk which are tabulated in the CHEMICAL NEWS of the 16th inst.

Dr. Voelcker's scheme of analysis appears to contain the following sources of error, some of which have been pointed out by Mr. Allen, but which may be conveniently recapitulated:—(1). The accurate weighing of 500 grains of milk in a dish is a matter of considerable difficulty, owing to the rapid evaporation which takes place from so large a surface of liquid, except the dish be very closely covered. This error is, however, unimportant. (2). The coagulation with acetic acid is a fertile source of error when the milk solids of so large a quantity of milk as 32 c.c. are to be dried till the weight is constant. The obtaining of anything like a constant weight necessitates a very prolonged exposure on the water-bath, and milk-sugar undergoes an appreciable loss when heated for long periods in acid solution. (3). It is impossible to obtain a constant weight by evaporating 500 grains of milk and drying at 100°; for whatever length of time the residue be exposed in the water, it still continues to lose weight. (4). The scraping of the residue from the dish, its pulverisation, re-drying, and re-weighing, must of necessity entail a loss, which will vary according to the skill of the operator. (5). The estimation of the nitrogen in one-fifth of the residue by combustion with soda-lime, is vicious. It has been more than once pointed out that the full yield of nitrogen is not obtained by the combustion of albumenoids with soda-lime. Recently Seegen and Novalk have shown (Pflüger's *Archiv. f. Physiologie*, vol. vi., p. 284) that the amount of nitrogen obtained in the form of ammonia by combustion of the albumenoids with soda-lime is always less than that obtained in the gaseous form by combustion with cupric oxide. This loss may be so much as 20 per cent of the total nitrogen. The "casein and albumen" of Dr. Voelcker is evidently calculated from the nitrogen by multiplying this by 6·25, and all errors in the estimation of nitrogen are multiplied by this factor. The method employed accounts for the very low percentage of casein and albumen met with in milk by Dr. Voelcker. (6). The extraction of fat from a fraction only of the dried residue is sure to introduce experimental errors; and this operation should be most carefully performed, since the difference between the fat and the total solids gives the "solids not fat," the most important element in a milk analysis. For my own part I invariably make a direct estimation of the solids not fat.

The column headed milk-sugar in Dr. Voelcker's table cannot possibly be reliable, since it gives the figures obtained by calculation, performed thus. The nitrogen obtained by a defective method—an amount which may be 20 per cent in deficit—is multiplied by 6·25. The number thus obtained is added to the fat also obtained by a defective method, and the product is deducted from the total solids, obtained by a method which never yields constant results. As a consequence we find the Cirencester herd yielding a milk more than half the solids (52 per cent) of which consisted of milk-sugar.

In this last very extraordinary milk the ratio of albumenoids to sugar was 1 to 2·3, and that of fat to sugar 1 to 2·9. I venture to doubt whether anyone else has ever analysed a similar milk.—I am, &c.,

THOMAS STEVENSON.

Guy's Hospital, July 24, 1875.

ON MILK ANALYSIS.

To the Editor of the Chemical News.

SIR,—In the second edition of Normandy's "Chemical Analysis" (date, 1865) the following grotesque statement concerning milk occurs, page 379:—"Pure milk always consists of from 90 to 93 per cent of water." And it is not a misprint, since it is backed up by such statements as that milk yields 7 per cent of solid residue, and that, "according to Pfaff and Swartz," the ash of milk is 0·3044 per cent, &c.

This extract illustrates the condition of official knowledge at the time of Dr. Voelcker's notorious investigation into the "Composition of Morning and Evening Milk produced on the Royal Agricultural College Farm, Cirencester," (date, 1863).

I saw in a recent blue book that some Government official had been quoting Dr. Voelcker's results of 1863 against the conclusions arrived at by me in my little book on "Milk Analysis."

To that official I commend the passage in Normandy's book of 1865, which is two years later than the notorious investigation, and is, if possible, still more in opposition to me. In a third edition of Dr. Normandy's "Chemical Analysis," edited by Dr. H. M. Noad, (date, 1875), I do not find the passage about 90 per cent, but I do find what purports to be Dr. Voelcker's method of milk analysis, page 270. According to this account (which purports to have been furnished by the Doctor himself) 500 grains of milk is dried down, and then there is a powdering and a second drying and a weighing out of portions of the dried and powdered residue. Caseine is determined by means of the Will and Varrentrapp process (the nitrogen being multiplied by 6·25), milk-sugar is determined by difference.—I am, &c.,

J. ALFRED WANKLYN.

THE MILK QUESTION.

To the Editor of the Chemical News.

SIR,—I am glad that Mr. A. H. Allen has pointed out in his recent letter that, from the analytical numbers quoted in your report of some recent cases of milk adulteration

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recently dismissed at Greenwich, the percentage of added water might have been stated at 12 per cent, or at even 15 per cent had the results been calculated from a standard of 9·3 per cent of total solids not fat. It has been my custom to "pass" a milk having a solid residue not fat of 9 per cent; but, in cases where there is no doubt that an adulteration has been practised, to calculate the amount of added water from the standard of 9·3 per cent of solids not fat. I think it only right and just for an analyst to assume that any sample of milk which he finds to be adulterated was, before adulteration, *at least* of average quality, and not of the very poorest possible quality consistent with its being a genuine milk. Referring to the complaints against some statements of Dr. Voelcker's, I suggest that it might be advisable for the Society of Public Analysts to lay before the Local Government Board the erroneous statements with regard to the analysis of milk made by Dr. Voelcker, together with the facts which prove that they are erroneous. Possibly, if copies of this were sent to the magistracy before whom the adulteration cases are brought, it would tend to place Dr. Voelcker's views on their proper basis, as compared with the present state of the knowledge of this subject.

It seems to be desirable, in my opinion, to establish as far as possible, for all analyses of foods, &c., a certain system of "standards" representing the specific indications afforded by the genuine articles. Doubtless, an enormous amount of work would have to be done, which would possibly take years to accomplish before that could be effected, because, for every sort of article, three points at least would have to be discovered, viz.,—(1) a trustworthy index, (2) what was actually the "standard," and (3) a perfectly safe and practical process for the analytical determinations of the samples being examined.

This has already been accomplished for milk, tea, very recently for butter, and something has also been done for cocoa mixtures (*i.e.*, the determination of the cocoa-fat). I should like to see these "standards," when thoroughly known to be accurate, made into legal definitions.

Moreover, I think that the use of such "standards" would overcome many difficulties, because the question then at issue would be, not whether a certain article was adulterated to a certain extent, but whether or not it was up to the "standard" for that article. This would prohibit the sale, unless under some such condition as information to the purchaser at the time of purchase, of articles actually genuine, but of such an inferior quality as to be worse than if intentionally adulterated; and, in the case of milk, it would prevent any magistrate from dismissing, almost with a blessing, a vendor of milk brought before him who sold milk so bad that, when viewed in its best possible aspect, was only equal in quality to the very poorest milk, *known to be genuine, plus* 10 per cent of added water.—I am, &c.,

CHARLES H. PIESSE.

303, Strand, London,
July 26, 1875.

MILK SOLIDS.

To the Editor of the Chemical News.

SIR,—The subject of "Milk Solids" is remarkable for its vitality. I had hoped by this time a fair standard had been agreed upon free alike from special starvation and exaggerated richness. The limit of the Society is fair, however, by the law of averages and no other; even at this a marginal line exists, a thin one perhaps, but "A cow is not yet a mathematical figure."

My object is to refer to another limit, butter fat. This is also agreed upon; but even the moderate figure of 2·5 per cent will create a positive injustice unless some more careful and perfect mode of distribution by the vendor is adopted. The proportion of cream in the first and the last issue from the common can has engaged the attention of some few experimentalists.

I anticipate the chance of doing a possible injustice by certificate, a matter that should dwell thoroughly in the mind of each Analyst, hence these few lines. The only suggestion I can make is, that as 99 per cent of samples are obtained by officers instructed to obtain—"the public not liking the office-of prosecutor"—an instruction to fairly obtain milk samples be given, and to that issue the officer should advise the vendors themselves. Failing some such action, discrepancies will occur leading to much difference of opinion, already wide enough.—I am, &c.,

EDWARD MOORE.

Brighton, July 24, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, tome lxxx., No. 25, June 28, 1875.

Distribution of Magnetism in a Thin Plate of Great Length.—M. J. Jamin.—The author has been engaged in studying the distribution of magnetism in a bundle of rods, commencing with the most simple case, that of a single broad plate, so long that it may be regarded as infinite, and of an equal thickness of 1 millimetre. He has experimented upon various pieces taken from a long and very homogeneous band of steel.

Distribution of an Acid among several Bases in Solution.—M. Berthelot:—Berthollet, who first took up the question of the distribution of acids and bases in solutions, admits that each acid and each base plays a part determined by its capacity of saturation and its quantity, that is to say, by its chemical mass. If the weights are equal, we should say, at present, that each body acts in the inverse ratio of its equivalent; whilst, if the two bases are employed in equivalent weights, they will each take the half of the acid. Such is the exact rendering of the language of Berthollet, which formally excludes every idea of an elective affinity or of a specific coefficient. But such distribution can only subsist if both the bases and the salts which they form remain in solution. If one of these bodies is withdrawn, whether by volatility or insolubility, a new distribution takes place in the liquid, and, in consequence, a new elimination; and so on until the totality of the eliminable compound is removed from the field of chemical action. Such are the principles of Berthollet's "Chemical Statics." Gay-Lussac invoked the same mechanism, but placing himself at a different point of view. He admits in solutions a sort of pell-mell, of equipollence of bases and acids shared out uniformly, the compounds which appear only originating in the moment when they are separated by insolubility, crystallisation, or volatility. These opinions the author has undertaken to examine by thermic methods, as far as the bases are concerned. He finds that the double salts, and the changes of the solvent, are not the cause of the phenomena observed; whilst, in the case of lime and ammonia, everything is explained by the chemical and total substitution of lime—an insoluble base for ammonia, a soluble base in the hydrochlorate of ammonia. We see thus that, contrary to the laws of Berthollet, a soluble base may be displaced in soluble salts by an insoluble base, which thus enters into solution.

Hydrocarbons Formed on the Distillation of Crude Fatty Acids in Presence of Superheated Steam.—MM. A. Cahours and E. Demarcay.—The hydrocarbons in question proved to be hydride of heptyl; hydride of octyl boiling between 118° and 120°; its specific gravity in the liquid state being 0·723, and its vapour-density 3·994, which agrees with the formula $C_{16}H_{18}$. Hydride of nonyl boiling between 138° and 140°, its specific gravity when liquid being 0·744, and its vapour-density 4·475. Hydride

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of decyl, boiling between 158° and 160°; specific gravity 0·758, vapour-density 4·978. Hydride of undecyl, boiling between 176° and 178°; specific gravity 0·770, vapour-density 5·488. Finally, a small quantity of a limpid liquid boiling towards 200°, with a specific gravity of 0·784. It is probably the hydride of duodecyl.

Note on Tubular Electro-Magnets with Multiple Nuclei.—M. Th. du Moncel.—A detailed examination of the action of Camacho's electro-magnets.

Note Accompanying the Presentation of Vol. I. of "Analytical and Experimental Exposition of the Mechanical Theory of Heat."*—M. Hirn.—The author seeks in this work to disentangle the science of thermodynamics from the metaphysical hypotheses by which it has been hitherto accompanied.

Influence of Compressed Air upon Fermentations.—M. P. Bert.—Oxygen at high pressures arrests fermentations, properly so called, which do not then reappear until the normal pressure is re-established. It kills the ferment germs. It is without appreciable action upon ferments of the diastase group, which it permits to remain active for an indefinite time. We comprehend that this new method of analysis may be usefully applied to the study of phenomena on which physiologists are still divided. Do the blood of carbuncle, the blood of infectious diseases, pathological liquids, animal poisons, &c., owe their action to corpuscles analogous to true ferments, or to an alteration of the fluids acting in the manner of a diastasic ferment?

Study of Electric Discharges in Fine Metallic Wires.—M. Melsens.—Not adapted for abstraction.

Influence of Magnetism upon the Extra Current.—M. Trève.—The author had formerly announced to the Academy that the intervention of magnetism had the effect of modifying the colouration of rarefied gases traversed by an induction current, and of transforming their spectra. It results from his present experiments that these effects are due as much to a change in the temperature of the gases as to a change in their pressure.

Chemical Equivalence of the Alkalies in the Ashes of Plants.—MM. P. Champion and H. Pellet.—In an earlier paper the authors have shown that the amounts of sulphuric acid necessary to saturate separately all the alkalies contained in the ash of beets (roots and leaves) may vary within remote limits, but that their sum is sensibly constant; or, in other words, that the partial substitution of alkalies takes place according to chemical equivalents. Further researches have led them to conclude that this law applies not merely to the beet, but to a great part of the vegetable kingdom, if not to the whole. They find in particular that, in the ash of tobacco, lime and potash replaceeach other according to their chemical equivalents.

Presence of the Peroxide of Hydrogen in the Sap of Plants.—M. J. Clermont.—It results from the researches of Schönbein and Meissner that the molecule of oxygen, which they regard as diatomic, is transformed under the influence of electricity into ozone (−) and antozone (+), one of the two atoms composing the molecule being charged with negative, and the other with positive electricity. Antozone, or electro-positive oxygen, cannot be produced without a parallel development of electro-negative ozone, and *vice versa*. M. Meissner has further shown that antozone has the power of causing water to pass to a higher state of oxidation, HO_2. On the other hand, it appears that a great part of the oxygen liberated by plants is found in the state of ozone. The author has, from these considerations, been led to seek for peroxide of hydrogen in the juice of a great variety of plants, such as tobacco, the vine, lettuce, &c. The plants were quickly bruised in a vessel containing distilled water, which being then examined with Schönbein's test—a mixture of iodide of potassium, starch, and a proto-salt of iron—gave distinct indications of the presence of peroxide of hydrogen.

Action of Chlorine upon Isobutyl-Hydriodic Ether.—M. Prunier.—If dry chlorine is passed into this ether, kept at a low temperature, at first C_8H_9Cl is formed, and iodine is thrown down. If the entrance of the gas is regulated so as to avoid heating, and the distillation of hydrochloric ether, chloride of iodine is formed, and substitution begins.

Supporting Power of M. Jamin's Magnets.—M. A. Sandoz.—The author finds that the magnets in question do not lose strength in time, but rather increase. That there is no sensible gain from leaving them with an armature, and that they preserve their power equally with or without. That the supporting power of a magnet whose load has been successively torn away varies somewhat, but, upon the whole, gains rather than loses.

* "L'Exposition Analytique et Expérimentale de la Théorie Mécanique de la Chaleur."

Justus Liebig's Annalen der Chemie, June 25, 1875.

New Apparatus for the Determination of Gases by Absorption.—Dr. G. von Liebig.—A long and important paper, which would not be intelligible without engravings.

Penta-Methyl-Athol and its Derivatives.—H. A. Butlerow.—The author has obtained a tertiary alcohol, which may be regarded as ethyl-alcohol in which the five hydrogen atoms of the radical are replaced by methyl groups. This compound he names penta-methyl-äthol. He has also examined the chloride of penta-methyl-ethyl, $C_7H_{16}Cl$, and the corresponding iodide.

Action of Bromine upon Protocatechuic Acid, Gallic Acid, and Tannin.—J. Stenhouse.—A detailed account of researches first published in the CHEMICAL NEWS, vol. xxix., p. 95.

Action of Bromine upon Brom-Pyro-Gallol, and Brom-Pyro-Catechin.—J. Stenhouse.—An abstract of this paper also appeared in the CHEMICAL NEWS, vol. xxix., p. 96.

Constitution of Completely Substituted Amidic and Phosphidic Acid: Compounds of Pentevalent Nitrogen and Phosphorus.—J. W. Brühl.—In this treatise the author describes the preparation of triethylated amido-acetic acid; the action of powerful bases upon the chloride of this compound; the elementary analysis of triethyl-glycocoll, $C_{18}H_{17}NO_2$; the action of hydrate of baryta upon triethyl-amido-acetic acid at high temperatures; and the results of the dry distillation of triethyl-amido-acetic acid.

Action of Aniline upon Dichlorhydrin.—Hugo Schiff.—On heating to 200° 1 molecule dichlorhydrin with 5 of aniline a crude mass was obtained, from which excess of aniline and hydrochlorate of aniline were removed by treatment with warm dilute acetic acid. The red vitreous residue was dissolved in absolute alcohol slightly acidulated with hydrochloric acid, and the solution mixed with ether. A slight red precipitate (A) was obtained. The filtrate, on evaporation, yielded the same vitreous mass, which was only partially dissolved on repeated digestion in dilute hydrochloric acid. A deep red granular mass (B) remained undissolved, whilst a yellow powder (C) was thrown down by ammonia from the hydrochloric solution. A is formed only in small amount. It is soluble in alcohol, insoluble in ether, water, and dilute hydrochloric acid. From its alcoholic solution it is precipitated by acidulated water as a brick-red powder, containing—

Carbon	73·2
Hydrogen	7·2

B, the main product of the reaction, forms, when purified like A, a deep red granular mass. The hydrochloric alcoholic solution yields, on gradual evaporation, a dichroic, red-green, unstable hydrochlorate, which yields hydrochloric acid if treated with water, but without dissolving. C in the moist state is chiefly re-soluble in dilute hydro-

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chloric acid, but if dried over sulphuric acid it becomes very sparingly soluble. It contains—

Carbon	77·4
Hydrogen	7·7

On Meta-Brom-Toluol.—Dr. E. A. Grete.—This paper treats of the preparation of meta-brom-toluol; of meta-brom-sulphitoluol and its calcium, strontium, magnesium, copper, lead, and potassium compounds; and concludes that the sulphi-acid produced by the reaction of meta-brom-toluol with fuming sulphuric acid, and corresponding to salicylic acid, belongs to the ortho series, and is consequently meta-brom-ortho-sulphi-toluol. The author further examines mono-nitro-meta-brom-toluol, mono-amido-meta-brom-toluol, meta-brom-amido-toluol sulphate, nitrate, hydrochlorate, and oxalate of meta-brom-toluydin; meta-brom-acettoluydin; dinitro-meta-brom-toluol; diamido-meta-brom-toluol, with its sulphate, hydrochlorate, nitrate, and oxalate.

Derivatives of Glycerin.—K. Kraut.—An examination of compounds formed by the action of iodides of ethyl and of methyl upon glycin in alcohol.

Action of Iodide of Methyl upon Alcohol.—E. Busse and K. Kraut.—10 c.c. iodide of methyl were heated for twelve hours to 120° to 125° along with 30 c.c. of commercial absolute alcohol. In the cooled liquid the iodine compounds were precipitated with water, washed, dried with chloride of calcium, and distilled. The greater portion of the liquid passed over above 65°. The part passing over at lower temperatures was again heated with the triple volume of alcohol, separated, washed, dried, and added to the portion first obtained. In this manner were obtained 10 grms. of a product boiling between 65° and 71°, from which mellitic-acid-ester was obtained by contact with mellitate of silver.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in apparatus for purifying sewage waters. James McIntyre, Port Glasgow, Renfrew, N.B. September 21, 1874.—No. 3225. In carrying out the invention, according to one modification, two depositing tanks are constructed side by side in the line of a sewer, and the sewer is connected to each by separate inlet and outlet branch passages fitted with sluices. Each tank is made to extend down a considerable depth below the sewer level, but the outlet from it is made higher than the inlet, and the sewage waters flow in and fill up the tank until they reach this higher discharge level, the water flowing off as it rises above that level. When a sufficient deposit has lodged in one tank, the sluices are changed so as to direct the sewage waters through the other tank, and the deposit in the first tanks is removed. The essential features are the arrangements for obtaining the deposition of suspended matters whilst the sewage waters flow continuously through the apparatus.

Improvements in the manufacture of soda and potash. James Mactear, chemist, of Glasgow, Lanark, North Britain. September 22, 1874.—No. 3242. By the present invention, a mixture of sulphate of soda or potash with coal and with a quantity of carbonate of lime barely in excess of the chemical equivalent is charged at one time into the furnace, and the heating operation is allowed to proceed until the reaction is nearly complete. At this point a small quantity, say 10 per cent, of crushed caustic lime is added; and then, as soon as this added caustic lime is thoroughly mixed with the other materials, the entire charge is withdrawn.

A new method of treatment of slops, bloody waters, and other forms of liquid refuse, and for apparatus to be used therein. Francis Thos. Bond, Gloucester. September 23, 1874.—No. 3326. The mode described consists of a combination of precipitation by certain chemical agents,—such as sulphuric acid, sulphate of alumina, &c., in the case of soapy waters, and sulphate of copper and bichromate of potash in the case of bloody waters,—with subsequent filtration, either by means of a floating strainer or a submerged filter specially constructed for the purpose. The process is carried on in a barrel, tub, or other appropriate vessel, open at the top and provided with a tap connected by india-rubber tubing with the strainer or filter aforesaid.

Improvements in the purification of sugar solutions. Charles Haughton Gill and George Martineau, both of Christian Street, Middlesex. September 29, 1874.—No. 3332. This Specification describes adding an excess of tannin to sugar solutions, and subsequently removing this excess by the addition of alumina.

Improvements in treating saccharine solutions to separate potash therefrom. Charles Haughton Gill and Francis Nelson Girdlestone Gill, both of Christian Street, Middlesex. September 29, 1874.—No. 3333. Oxalic acid is the agent employed.

Improvements in the process and apparatus employed in the making and condensing of oxygen and hydrogen gases. Joseph Beck, optician, Cornhill, London. (A communication from N. H. Edgerton, Philadelphia, Pennsylvania, U.S.A.) October 2, 1874.—No. 3376. The process consists in the making and condensing, by molecular action, oxygen and hydrogen gases in a solid wrought-iron cylinder of peculiar construction.

Improvements in the treatment of human excreta, and in the manufacture of manure therefrom, and in the apparatus employed therein. Francis Alcidi Bonnefin, Island of Mauritius, at present residing at Queen Street, Cheapside, London. October 3, 1874.—No. 3334. My invention relates to the treatment of human excreta and to the production of manure therefrom, and consists of a peculiar process of and apparatus for effecting the deodorisation or disinfection of the solid and liquid portions together, and of the liquid portions separately, in order to fix the salts and gases, and render the excreta capable of being employed as a manure for agricultural purposes.

Improvements in preserving wood. Alexander Melville Clark, patent agent, Chancery Lane, Middlesex. (A communication from Henri Nicolas Rogé, Edouard Péret, Pierre Hypolite Baffoy, and Pierre Stanislas Eléonore Dupré, all of Paris, France). October 3, 1874.—No. 3392. The invention consists in the use in combination of a salt of lead and a reagent capable of producing an insoluble compound of lead by precipitation, after impregnating the pores of the wood for the purpose of preserving the same.

A new method for the saving of nitre in the manufacture of sulphuric acid, and apparatus therefor. Thomas Scott, The Glen, Cork, Ireland. October 6, 1874.—No. 3417. A series of tanks are arranged to receive the gases, sulphurous and nitrous, from furnaces, the gases passing through tubes, some containing flints and others coke, to separate the gas from the other after the acid has been condensed in the tanks.

Improvements in the mode of treating and clarifying sewage or other impure waters. Samuel Hallsworth, Armley, near Leeds, and Richard Bailes, Woodhouse Carr, Leeds, both of York. October 9, 1874.—No. 3459. This consists in the employment of liquid obtained from beds of iron pyrites. Means are described for treating the impure waters.

Improvements in the manufacture of ammoniacal salts. Henry Young Darracott Scott, Major-General, C.B., Ealing, Middlesex. October, 9, 1874.—No. 3472. The object of this invention is to obtain salts of ammonia from ammoniacal phosphate of magnesia in an economical manner, so that after the extraction of the ammonia from that substance the phosphate of magnesia may be again used for the extraction of fresh portions of ammonia from gas liquor, decomposed urine, and other ammoniacal liquids.

Improvements in obtaining chlorine. Joseph Townsend, manufacturing chemist, Glasgow, Lanark, North Britain. October 10, 1874.—No. 3483. This invention has for its object the obtaining of chlorine in a better and more economical manner than heretofore, and consists in passing gaseous hydrochloric acid and atmospheric air in contact with heated mixtures or compounds of manganese and magnesium or their oxides, a result of the reaction taking place being the evolution of chlorine, which may be utilised or applied in any suitable known way.

Improvements in the preparation of anodes of nickel for the purpose of nickel plating. John Wm. Perkins, Arlington Lodge, Herne Hill Road, Brixton, Surrey. October 19, 1874.—No. 3587. The novelty of this invention consists in alloying tin with nickel.

Improvements in the extraction of metals from their ores. Stephen Henry Emmens, scientific referee, Old Jewry, London. October 21, 1874.—No. 3609. This relates to the use of fluor spar in the roasting process, a solution of salt or saltpetre in the lixiviating process, and iron pyrites in the precipitating process.

Improvements in the means of purifying and clarifying the refuse water of breweries, distilleries, sugar refineries, starch works, laundries, and similar establishments wherein water is contaminated. Frederick Arthur Paget, engineer, Seymour Chambers, Adelphi, London, and Riemer Gasse Stadt, Vienna, Austria. (A communication from Jean Alexandre Bérenger, engineering inspector of the Austrian Southern Railway, and Johann Stingl, private tutor in the Chemical Laboratory of the Imperial and Royal Polytechnic Institution, both persons resident at Vienna, Austria). October 20, 1874.—No. 3613. The preliminary treatment of such water. First, with a mixture of sesquichloride of iron and of chloride of aluminum. Treating water already so prepared with milk of lime or with lime-water. The employment for these purposes of a self-acting apparatus continuous in its action, substantially as described in Specification No. 3953, A.D. 1873. The use of the mixture as described prepared by the reaction of hydrochloric acid on argillaceous iron ore containing phosphorus. Employing any known disinfecting substance for treating water previously prepared by the method substantially as described.

Improvements in dyeing threads, yarns, and fabrics aniline-black. Alexander Melville Clark, patent agent, Chancery Lane, Middlesex. (A communication from William Jules Samuel Grawitz, Paris, France). October 21, 1874.—No. 3632. This invention relates to dyeing all kinds of fibres, yarns, threads, or fabrics black, or shades approaching thereto, by means of oil of aniline or its salts, and the following reagents, viz.:—1st, soluble chromate or bichromate. 2nd, soluble chlorate; and 3rdly, salt of iron or copper at a maximum degree of basic oxidation.

TO CORRESPONDENTS.

ERRATA.—Page 28, line 32 from top, *for* "powerful" *read* "prompt," line 37, *for* "20" *read* "29;" line 11 from bottom, *for* "this" *read* "then."

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THE CHEMICAL NEWS.

VOL. XXXII. No. 819.

PRELIMINARY NOTICE OF

FURTHER RESEARCHES ON THE PHYSICAL PROPERTIES OF MATTER IN THE LIQUID AND GASEOUS STATES UNDER VARIED CONDITIONS OF PRESSURE AND TEMPERATURE.*

By Dr. ANDREWS, F.R.S.,
Vice-President of Queen's College, Belfast.

(Concluded from page 44).

Law of Gay-Lussac.—That the law of Gay-Lussac in the case of the so-called permanent gases, or in general terms of cases greatly above their critical points, holds good at least at ordinary pressures, within the limits of experimental error, is highly probable from the experiments of Regnault; but the results I have obtained with carbonic acid will show that this law, like that of Boyle, is true only in certain limiting conditions of gaseous matter, and that it wholly fails in others. It will be shown that not only does the coefficient of expansion change rapidly with the pressure, but that, *the pressure or volume remaining constant, the coefficient changes with the temperature.* The latter result was first obtained from a set of preliminary experiments, in which the expansion of carbonic acid under a pressure of 17 atmospheres was observed at 4°, 20°, and 54°; and it has since been fully confirmed by a large number of experiments made at different pressures and well-defined temperatures. These experiments were conducted by the two methods commonly known as the method of constant pressure and the method of constant volume. The two methods, except in the limiting conditions, do not give the same values for the coefficient of expansion; but they agree in this respect, that at high pressures the value of that coefficient changes with the temperature. While I have confined this statement to the actual results of experiment, I have no doubt that future observations will discover, in the case, at least, of such gases as carbonic acid, a similar, but smaller, change in the value of the coefficient for heat at low pressures. The numerous experiments I have made on this subject will shortly be communicated in detail to the Society; and for the present I will only give the following results:—

Expansion of Heat of Carbonic Acid Gas under High Pressures.

Pressure. Atmospheres.	Vol. CO_2 at 0° and 760 m.m.=1.	Vol. CO_2 at 6·05° and 22·26 At.=1.	Temperature. Degrees.	
22·26	0·03934	1·0000	6·05	
22·26	0·05183	1·3175	63·79	(A)
22·26	0·05909	1·5020	100·10	

Pressure. Atmospheres.	Vol. CO_2 at 0° and 760 m.m.=1.	Vol. CO_2 at 6·62° and 31·06 At.=1.	Temperature. Degrees.	
31·06	0·02589	1·0000	6·62	
31·06	0·03600	1·3905	63·83	(B)
31·06	0·04160	1·6068	100·64	

Pressure. Atmospheres.	Vol. CO_2 at 0° and 760 m.m.=1.	Vol. CO_2 at 6·01° and 40·06 At.=1.	Temperature. Degrees.	
40·06	0·01744	1·0000	6·01	
40·06	0·02697	1·5464	63·64	(C)
40·06	0·03161	1·8123	100·60	

* A Paper read before the Royal Society.

Taking as unit 1 vol. of carbonic acid at 6·05° and 22·26 atmospheres, we obtain, from series A, the following values for the coefficient of heat for different ranges of temperature:—

$\alpha = 0{\cdot}005499$ from 6·05° to 63·79°.
$\alpha = 0{\cdot}005081$ from 63·79° to 100·10°.

From series B, with the corresponding unit volume at 6·62° and 31·06 atmospheres, we find:—

$\alpha = 0{\cdot}006826$ from 6·62° to 63·83°.
$\alpha = 0{\cdot}005876$ from 63·83° to 100·64°.

And in like manner, from series C, with the unit volume at 6·01° and 40·06 atmospheres:—

$\alpha = 0{\cdot}009481$ from 6·01° to 63·64°.
$\alpha = 0{\cdot}007194$ from 63·64° to 100·60°.

The coefficient of carbonic acid under 1 atmosphere referred to a unit volume at 6° is—

$\alpha = 0{\cdot}003629$.

From these experiments, it appears that the coefficient of expansion increases rapidly with the pressure. Between the temperatures of 6° and 64° it is once and a half as great under 22 atmospheres, and more than two and a half times as great under 40 atmospheres, as at the pressure of 1 atmosphere. Still more important is the change in the value of the coefficient at different parts of the thermometric scale, the pressure remaining the same. An inspection of the figures will also show that this change of value at different temperatures increases with the pressure.

Another interesting question, and one of great importance in reference to the laws of molecular action, is the relation between the elastic forces of a gas at different temperatures while the volume remains constant. The experiments which I have made in this part of the inquiry are only preliminary, and were performed, not with pure carbonic acid, but with a mixture of about 11 volumes of carbonic acid and 1 volume of air. It will be convenient, for the sake of comparison, to calculate, as is usually done, the values of α from these experiments; but it must be remembered that α here represents no longer a coefficient of volume, but a coefficient of elastic force.

Elastic Force of a Mixture of 11 vols. CO_2 and 1 vol. Air Heated under a Constant Volume to Different Temperatures.

Vol. CO_2.	Temperature. Degrees.	Elastic Force. Atmospheres.	
366·1	13·70	22·90	
366·2	40·63	25·74	(A)
366·2	99·73	31·65	
256·8	13·70	31·18	
256·8	40·66	35·44	(B)
256·8	99·75	44·29	

From series A we deduce, for a unit at 13·70° and 22·90 atmospheres:—

$\alpha = 0{\cdot}004604$ from 13·70° to 40·63°.
$\alpha = 0{\cdot}004367$ from 49·63° to 99·73°.

And from series B:—

$\alpha = 0{\cdot}005067$ from 13·70° to 40·66°.
$\alpha = 0{\cdot}004804$ from 40·66° to 99·75°.

The coefficient at 13·70° and 1 atmosphere is—

$\alpha = 0{\cdot}003513$.

It is clear that the changes in the value of α, calculated from the elastic forces under a constant volume, are in the same direction as those already deduced from the expansion of the gas under a constant pressure. The value of α increases with the pressure, and it is greater at lower than at higher temperatures. But a remarkable relation exists between the coefficients in the present case which does not exist between the coefficients obtained from the expansion of the gas. The values of α, deduced for the same range of temperature from the elastic forces at different

pressures, are directly proportional to one another. We have, in short—

$$\frac{0.004367}{0.004604}=0.9485, \qquad \frac{0.04804}{0.05067}=0.9481.$$

How far this relation will be found to exist under other conditions of temperature and pressure will appear when experiments now in progress are brought to a conclusion.

Law of Dalton.—This law, as originally enunciated by its author, is, that the particles of one gas possess no repulsive or attractive power with regard to the particles of another. "Oxygen gas," he states, "azotic gas, hydrogenous gas, carbonic acid gas, aqueous vapour, and probably several other elastic fluids, may exist in company under any pressure and at any temperature without any regard to their specific gravities, and without any pressure upon one another." The experiments which I have made on mixtures of carbonic acid and nitrogen have occupied a larger portion of time than all I have yet referred to. They have been carried to the great pressure of 283·9 atmospheres, as measured in glass tubes by a hydrogen manometer, at which pressure a mixture of 3 volumes of carbonic acid and 4 volumes of nitrogen was reduced, at 7·6°, to $\frac{1}{87}$th of its volume without liquefaction of the carbonic acid. As this note has already extended to an unusual length, I will not now attempt to give an analysis of these experiments, but shall briefly state their general results. The most important of these results is *the lowering of the critical point by admixture with a non-condensable gas.* Thus, in the mixture mentioned above of carbonic acid and nitrogen, no liquid was formed at any pressure till the temperature was reduced below −20° C. Even the addition of only $\frac{1}{10}$th of its volume of air or nitrogen to carbonic acid gas will lower the critical point several degrees. Finally, these experiments leave no doubt that the law of Dalton entirely fails under high pressures, where one of the gases is at a temperature not greatly above its critical point. The anomalies observed in the tension of the vapour of water when alone and when mixed with air find their real explanation in the fact that the law of Dalton is only approximately true in the case of mixtures of air and aqueous vapour at the ordinary pressure and temperature of the atmosphere, and do not depend, as has been alleged, on any disturbing influence produced by a hygroscopic action of the sides of the containing vessel. The law of Dalton, in short, like the laws of Boyle and Gay-Lussac, only holds good in the case of gaseous bodies which are at feeble pressures and at temperatures greatly above their critical points. Under other conditions these laws are interfered with; and in certain conditions (such as some of those described in this note) the interfering causes become so powerful as practically to efface them.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 26.)

This report resulted from the minute investigations of MM. Péligot, Lamy, Troost, De Mondésir, and Le Blanc, who had been appointed as commissioners by the Prefect of the Seine in 1869. They undertook an examination of the process in the Place de l'Opera as well as in the laboratory. They burnt ordinary gas, bog-head gas, and gas saturated according to different systems with liquid hydrocarbons, along with about half its volume of oxygen, and making use of various burners. They came to the conclusion that, for an equal intensity of light, the process of Tessié du Motay is almost always dearer—generally twice as dear—as the ordinary mode of lighting. In one case only, where the liquid hydrocarbons of the Boghead coal were used for carburetting by absorption in wicks, according to the plan of Levêque, over which the gas passed, it was found that the new process was twice as cheap as the ordinary method. This, moreover, applied only to the use of large burners, and the consequent production of great quantities of light. All the figures given by Tessié du Motay's Company, as to the cost of oxygen and the expense of carburetting, were taken for granted. In fact, however, it appeared that, in this experiment, 1 cubic metre of gas took up, not 50 grms. of liquid hydrocarbons, as the Company stated, but 266 grms., which rendered the economy of the process at any rate doubtful. As regards the strength of the light, the commissioners found it from three to seven times greater than that of common coal-gas. But Boghead gas in suitable burners can be made to yield a light three times stronger than that of coal-gas without the aid of pure oxygen. For most purposes, moreover, a very great intensity of light is not desired, as we see it reduced to 30 per cent by means of glass shades and screens.

The conclusion of the commission, therefore, was to advise the municipality of Paris not to permit the laying down of mains for oxygen gas, but to leave it to the Company to furnish oxygen and carburetted gas in portable gasometers to such persons as required an intense light.

The results obtained in Brussels were not more favourable. Lighting with oxygen was tried there last year for a short time in some coffee-houses and in the Passage St. Hubert, and given up on account of the above-mentioned disadvantages.* In Vienna, in April, 1874, the Westbahnhof was still lighted up with oxygen; but the system had made no further progress in that city, and the bluish moon-like light, in spite of its intensity and beauty, as represented above, was regarded as unsatisfactory.† The jury of the Vienna Exhibition examined the oxygen illumination at the Westbahnhof (Western Railway Terminus). In the Exhibition itself the manufacture of oxygen was not represented.

Should further experience confirm these decisions, the manufacture of oxygen would be deprived of its present foundations. For it has been undertaken solely in the hope of the application of the oxygen to lighting purposes.

Many of the above-mentioned disadvantages, and especially the cost of the mains, are evaded in the arrangement which Phillips‡ proposes for oxygen illumination. This depends on lamps (manufactured by Berghausen, of Cologne), fed from an oil-cistern with very heavy tar-oil, rich in naphthalin, whilst oxygen is introduced into the centre of the wick. Whether great cities will be induced to give up the advantages of gas-lighting in favour of this arrangement, and whether it is practicable on the large scale, must be considered very doubtful.

(To be continued.)

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

* Letters from M. Melsens, Professor of Chemistry in Brussels, to Professor A. W. Hofmann, April 14th, 1874.

† Verbal communications from H. Hlasiwetz, Professor of Chemistry at the Polytechnicum in Vienna.

‡ Phillips, "Der Sauerstoff," Berlin, 1871, p. 46.

ON A METHOD OF
MEASURING REFRACTIVE INDICES WITHOUT THE USE OF DIVIDED INSTRUMENTS.

The importance of an accurate determination of all the physical constants which characterise any substance having a definite chemical constitution becomes daily more and more evident. The researches of Gladstone, Landolt, and others have shown that indices of refraction possess a peculiar value and interest. As the instruments necessary for their determination are expensive, and often

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beyond the reach of working chemists, a simple and sufficiently accurate method of measuring them by means of the spectroscope alone will doubtless be welcomed.

The method which I propose is one of comparison, and applies with convenience only to the case of liquids. A hollow prism is to be filled with the liquid to be examined, placed upon the stage of the spectroscope, and turned until a given ray—the line D, for instance—is seen by the observing telescope to be in the position of minimum deviation. The eye-piece of the telescope should have two parallel spider-lines placed very near each other in the plane of the diaphragm. When the dispersion is sufficiently great to separate the line D into its two components, either component may be made to bisect the interval between the two spider-lines, or the two components may be made to occupy such positions that their middle line shall bisect the interval. The observing telescope is then to be firmly clamped. The prism is now to be removed, the liquid poured out, and the prism cleaned and dried carefully. It is then to be filled with any liquid the indices of refraction of which are known, and which the observer judges to have a mean index not greatly differing from that of the liquid to be measured. The prism is to be placed upon the stage of the spectroscope, and turned until the observer ascertains that the two spectra would be in the field of view if both could be seen at the same time; or, what is the same thing, that they would be more or less completely superposed. Should this not be the case, another comparison-liquid must be chosen, and so on until one is found which fulfils the requisite conditions. Supposing that this is successfully accomplished, the prism is to be turned until, for the position of minimum deviation, a known line in the spectrum exactly bisects the interval between the two spider-lines. The index of refraction of the given liquid for the line D is then the same as that of the known line in the spectrum of the liquid used for comparison; for we have for each case—

$$n=\frac{\sin.\ \frac{1}{2}(P+D)}{\sin.\ \frac{P}{2}}\quad n'=\frac{\sin.\ \frac{1}{2}(P+D')}{\sin.\ \frac{P}{2}},$$

and, since P is constant, and $D'=D$, it follows that $n'=n$.

By this method, the index of refraction of a given liquid may be determined for a single line; as, for instance, for D. This is sufficient for the optical analysis in the form in which it has been developed by Landolt. Two objections to this method present themselves at once. The first is the necessity of finding, by tentative processes, a comparison-liquid which shall have about the same mean index of refraction as the liquid an index of which is to be determined. I admit the force of the objection, but it must not be estimated too highly. Whole classes of liquids agree pretty nearly in their optical characters; as, for instance, the oils of the $C_{10}H_{16}$ series, the ethers of the fatty acids, hydrocarbons, and saline solutions. The second objection is, that, with liquids of low dispersive powers, it is not easy to distinguish the spectral lines with absolute certainty. This difficulty is easily avoided by using a second prism, with a high dispersive power, placed next to the collimator, so as to form a long spectrum, which shall fall upon the trial-prism. The final dispersion is then the sum of the dispersions of the two prisms, and no difficulty will be found in distinguishing the spectral lines. It is, of course, necessary that the subsidiary prism shall have the same position in both cases. Two or more subsidiary prisms, either of flint-glass or of carbonic disulphide, may be used with great advantage, but one will usually be found sufficient. The indices of refraction of the comparison-liquids being known for at least three lines, the values of the constants, a, b, and c, in Cauchy's formula—

$$n=A+\frac{B}{\lambda_2}+\frac{C}{\lambda_4},$$

may be determined. It then only remains to compute the index of refraction of the line which has been found to have the same index as the line D, for instance, of the liquid examined. This is easily done when the line in question has been identified by means of Kirchhoff's char, so that its wave-length is known. It will, of course, often happen that no line in the comparison-liquid exactly corresponds with the line D selected for the liquid examined. In this case the index of the nearest line may be employed instead, when great accuracy is not required and when subsidiary prisms are used, or we may use a filar micrometer, and interpolate so as to obtain the index of a coincident line by measuring the distance of the relative line D from one or more visible lines in the comparison-spectrum. The eye-piece micrometer suggested by Professor Rood* would also give all necessary precision, and would have the advantage of being very much cheaper than a filar micrometer.

The method above given enables us to determine the index of refraction of a single line only, unless the prism is emptied, cleaned, dried, and the operation then repeated with a second selected line. To obviate this difficulty, I have employed the following modification of the prism with entire success. The prism is divided into two by a septum perpendicular to its refracting edge. Each prism thus formed has an opening in its base by which liquid may be introduced or removed, and which can be closed with a cork. When the two glass plates are carefully cemented to the brass frame, the two prisms will have the same refracting angle. One of them is then to be filled with the comparison-liquid, the other with the liquid the indices of which are to be determined. The double prism being now placed upon the stage of the spectroscope, one face of the prism containing the comparison-liquid is to be covered with a slip of metal. The spectrum of the liquid to be examined will then be seen by means of the observing telescope. Any line—as, for instance, C—may then be selected, brought into the position of minimum deviation, and the telescope adjusted until this line bisects the space between the parallel wires in the plane of the diaphragm of the eye-piece. The telescope is then to be clamped as before without disturbing the adjustment. If now one face of the prism containing the liquid examined be covered with the slip of metal removed from the face of the other prism, the spectrum of the comparison-liquid will be seen, and it will be easy to determine what line in this spectrum most nearly corresponds in position to the line C of the other spectrum. By alternately covering the faces of the two prisms with the metal slip, coincidences, or near coincidences, may be observed for D, E, F, &c.; and in this manner the data obtained for the constants in Cauchy's dispersion formula for the liquid examined, in a short time and with great facility. It must be borne in mind that the two spectra in this process cannot be seen simultaneously, their images being combined by the observing telescope into one.†

In applying the above methods, I have used prisms with brass frames, and have cemented the glass plates either with common or marine glue, the latter being employed for aqueous solutions. Good workmanship would, doubtless, make it possible to fit the plates to the sides of the prisms so that they could be held in their places by springs, the prisms being perfectly tight; but I have not found this to be the case with prisms from German workshops which I have examined.

The process which I have given above furnishes, of course, a new application of the spectroscope to quantitative chemical analysis—all the results obtained by Landolt with the spectrometer being obtained with the spectroscope alone; but it is hardly necessary to say that a good spectrometer is an instrument greatly to be preferred, since it may be used also as a spectroscope, and since direct methods are always better than those of comparison.—*Proceedings of the American Academy of Arts and Sciences.*

* *Am. Journ. Sci.*, 3rd series, vol. vi., p. 44.

† Mr. S. P. Sharples has suggested to me that, if a cylindrical were employed as the object-glass of the observing telescope, the spectra could be seen in the field at the same time.

ON A

DEPOSIT OF GYPSUM IN SOUTHERN UTAH.

By ALEX. T. MACHATTIE, Ph.D., F.C.S., Glasgow.

On the road from Salt Lake City to the southern portion of Utah, one of the places at which the mail-coaches change horses is White Mountain, where, near the road, there is a large mound, of an almost pure white colour, from which, I presume, the place derives its name. The mound from a distance looks like a huge heap of white sand drifted into its present position by the wind, and lies in a valley or basin partly surrounded by low hills. On examination I found it to consist of small white—or almost white—particles, about the size of ordinary seasand, these being kept together by a covering of scanty vegetation. On analysis I found the following to be the composition of the powder:—

Water	20·05
Calcium sulphate	75·39
Calcium carbonate	3·53
Magnesium carbonate	traces
Siliceous matter	0·90
Loss, with very slight trace of organic matter	0·13
	100·00

The amount of water required to convert 75·39 of anhydrous calcium sulphate into gypsum being 19·85, it is evident, from the above analysis, that the mound consists practically of gypsum containing a notable amount of calcium carbonate. The powder under the microsocope is seen to consist of small water-worn particles of the gypsum in the *fibrous* form. The presence of so considerable a proportion of carbonate of lime in the gypsum, and, more particularly, the peculiar position and mechanical condition of such a large mound of that mineral, seem to me worthy of note.

OUTLINES OF A BIBLIOGRAPHY OF THE HISTORY OF CHEMISTRY.*

By H. CARRINGTON BOLTON.

Boerhaave, Herman. *Elementa Chemiæ.* Paris, 1724. Also an English translation as follows:—"A new Method of Chemistry, including the theory and practice of that art laid down on mechanical principles and accommodated to the uses of life. * * * To which is prefixed a Critical History of Chemistry and Chemists from the origin of the art to the present time. Written by the very learned H. Boerhaave. * * * Translated by P. Shaw, M.D., and E. Chambers." 4to. London, 1727.

A logically arranged, condensed history of chemistry, forming the introduction to a very remarkable work of one of the most distinguished men of the time. (Boerhaave, born 1668, died 1738).

Du Fresnoy, Lenglet. *Histoire de la Philosophie Hermétique. Accompagné d'un Catalogue raisonné des Ecrivains de cette Science. Avec le véritable Philalethe, revu sur les originaux.* 3 vols. 12mo. Paris, 1742.

The author of this exceedingly curious work was an Abbé of some distinction as a *littérateur.* He was born in 1674, and died in 1755. While apparently accepting the truth of the legends relating to the great antiquity of alchemy, and narrating accounts of veritable transmutations at considerable length, he at the same time exposes the frauds practised by the adepts, and quotes entire the celebrated essay of Geoffroy: "Des Supercheries concernant la Pierre Philosophale," which rang the death knell of the Hermetic art.

The first volume of Du Fresnoy's work contains only historical matter, concluding with a "Chronologie des plus célèbres auteurs de la philosophie hermétique." In this chronology, which begins with "Hermes, 1996 B.C.," he includes Moses, Cleopatra, and Caligula, *adepts* being marked by an asterisk. The second volume continues the history, and includes the "Introitus apertus ad occlusum regis palatium" of Philalethes, entire, both in French and in Latin. The third volume consists of a compendious Bibliography of Chemistry embracing the works of a thousand authors.

Schröder, Fr. Jos. Wilh. *Geschichte der ältesten Chemie und Philosophie.* 8vo. Marburg, 1775.

Schröder was Professor of Chemistry and Medicine at the University of Marburg. This work is written in defence of the "Higher Chemistry," a term applied to alchemy by Wenzel, shortly before.

Wiegleb, J. C. *Historisch-kritische Untersuchung der Alchemie oder der eingebildeten Guldmacherkunst.* 8vo. Weimar, 1777.

A severe criticism on the claims of hermetical philosophy.

Bergman, Torbern. *De primordiis Chemiæ.* Upsala, 1779.

Bergman, Torbern. *Historiæ chemiæ medium seu obscurum ævum.* Upsala, 1782.

Bergman, born 1735, died 1784, was Professor of Chemistry at the University of Upsala. The above essays were presented to the Academy of Sciences in Stockholm.

Baumer, J. W. *Bibliotheca Chemica.* Giessen. 8vo. 1782.

Wiegleb, J. C. *Geschichte des Wachsthums und der Erfindungen in der neuern Zeit.* 2 vols. 8vo. Berlin, 1790.

This covers the period from 1650 to 1790; the matter is chronologically arranged.

Wiegleb, J. C. *Geschichte des Wachsthums und der Erfindungen in der Chemie in den altesten und mittleren Zeiten.* 8vo. Berlin, 1792.

This is a translation of Bergman's works above mentioned.

Beckmann, Johann. *Beitrage zur Geschichte der Erfindungen.* 5 vols. 8vo. Leipzig, 1780—1805.

Gmelin, J. F. *Geschichte der Chemie seit dem Wiederaufheben der Wissenschaften bis an das Ende des 18 Jahrhunderts.* 3 vols. 8vo. Göttingen, 1797.

An unwieldy work, with a stupendous amount of detail, badly arranged. It excels in bibliographical references.

Reuss, J. D. *Repertorium Commentationum a Societatibus litterariis editarum secundum disciplinarum ordinem digessit J. D. Reuss.* 4to. Göttingæ, 1803. (Scientia-Naturalis. Chemia, &c. Vol. III.)

An exceedingly useful work, compiled with great diligence. Comprises sixteen volumes, of which the third volume of the division of natural science is devoted to chemistry and metallurgy. The whole work forms a proper introduction to the "Catalogue of Scientific Papers" published by the Royal Society, which covers the years 1800 to 1863.

Johnson, ————. *History of the Progress of Animal Chemistry.* 3 vols. London, 1803.

Fuchs, G. Fr. Chr. *Repertorium der chemischen Litteratur von 494 vor Christi Geburt bis 1806, in chronologischer Ordnung aufgestellt.* 8vo. Jena und Leipzig, 1806-12.

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* From the *Annals of the Lyceum of Natural History, N. Y.*, vol. x.

This work is highly praised by Petzholdt, as exceedingly compendious and carefully prepared. It contains not only independent works, but also articles from periodical literature, to which are added numerous biographical and literary notes. Actually, it extends only to 1799, inclusive; the proposed third volume (1800 to 1806) never appeared.

Barrett, Fr. *The Lives of Alchemystical Philosophers; with a critical catalogue of books in occult chemistry and a selection of the most celebrated treatises on the theory and practice of the Hermetic Art.* 8vo. London, 1815.

Contains superficial biographies of 45 so-called adepts, a list of 750 alchemical books, and selections from the most incredible treatises on the hermetic art. Bibliographically it is very inexact.

Davy, Sir Humphry. *Historical View of the Progress of Chemistry, in Davy's Collected Works.* Vol. IV. London, 1829.

A brief sketch.

Thomson, Thomas. *A History of Chemistry.* 2 vols. 12mo. London, 1830.

A very entertaining and useful work, embracing the whole field up to the date of publication. The progress of analytical chemistry is reviewed with critical skill.

Callisen, A. C. P. *Medicinishes Schriftsteller Lexicon der jetzt lebenden Aerzte, Wundaerzte, Geburtshelfer, Apotheker und Naturforscher* * * 33 vols. 12mo. Kopenhagen, 1830—1845.

A wonderfully exhaustive and laborious compilation, replete with minutest details concerning the literature of medicine and natural science. Chemistry proper, though not included in the title of the work, receives its full quota of attention. The author sacrificed a fortune in compiling and publishing these numerous and closely printed volumes.

Schmieder, Karl Christoph. *Geschichte der Alchemie.* 8vo. Halle, 1832.

Schmieder was born at Eisleben, in 1778, and was Director of a High School and School Inspector in Cassel, at which place he died in 1850. Several minor works on geology and mineralogy appeared from his pen, but none of such extraordinary character as this History of Alchemy, in which he endeavours to establish, by historic proofs, the reality of the transmutation of metals. Schmieder recognises two distinct sciences, chemistry and alchemy, and claims they exist independently of each other from the earliest ages. Alchemy, he states, has a threefold dogma.—1. It is possible to prepare, by true art, perfect gold from substances which contain no gold. 2. The same is true of silver. 3. This artificial preparation is a wonderful medicine, a panacea of life. Starting with this statement he investigates the authenticity of the historic records of transmutation, and sparing no pains in deciphering musty manuscripts of a former age, he concludes that we must acknowledge the reality of the transmutation of metals. He confesses that impostors abounded, but thinks he establishes the claims of five persons as true adepts, and gives their personal history with narratives of their wonderful accomplishments. He calls attention to the fact that the five persons named lived at succeeding periods and concludes that the Philosopher's Stone was secretly handed down from one to the other.

The whole aim and scope of this strange work, and especially the conclusions drawn, seem more appropriate to the times of Borrichius than to the second quarter of the enlightened 19th century.

Hoefer, Ferdinand. *Histoire de la Chimie.* 2 vols. 8vo. Paris, 1842. (Second edition in 1866).

A work of great research, especially in regard to earliest authentic records as derived from ancient manuscripts.

Kopp, Hermann. *Geschichte der Chemie.* 4 vols. 8vo. Braunschweig, 1843.

A classical work, above praise. Is somewhat scarce; a new edition in Roman type is desirable.

Wolff, Emil Theodor. *Quellen-Literatur der theoretisch-organischen Chemie oder Verzeichniss der vom Anfang des letzten Viertheils des vorigen Jahrhunderts bis zum Schluss des Jahres* 1844 *ausgeführten chemischen Untersuchungen.* * * * 8vo. Halle, 1845.

A carefully collated index to the researches in organic chemistry within the period named.

Wolff, Emil Theodor. *Vollstandige Uebersicht der elementar analytischen Untersuchungen organischer Substanzen.* * * * *Aus den chemischen Journalen* * * * *in systematischer Ordnung entworfen.* 8vo. Halle, 1846.

Wagner, Rudolf. *Die Geschichte der Chemie. Von der Kindheit des Menschengeschlechts bis auf unsere Tage.* 8vo. Leipzig, 1853.

Figuier, Louis. *L'Alchimie et les Alchimistes. Essai historique et critique sur la philosophie hermétique.* 12mo. Paris, 1855.

A readable work, founded mainly on Schmieder's Geschichte der Alchemie.

Poppe, Adolph. *Chronologische Uebersicht der Erfindungen und Entdeckungen auf dem Gebiete der Physik, Chemie, Astronomie, Mechanik und industriellen Technik von den altesten Zeiten bis auf unsere Tage.* 8vo. Frankfurt, 1856.

Zuchold, Ernst Amandus. *Bibliotheca Chemica. Verzeichniss der auf dem Gebiete der reinen pharmaceutischen physiologischen und technischen Chemie in den Jahren* 1840, *bis mitte* 1858 *in Deutschland und im Auslande erschienenen Schriften.* 8vo. Göttingen, 1859.

A most complete contribution to special bibliography. All the works bearing chemistry in their title, or relating to the subject, issued between the years named, in twenty-one different languages, are here alphabetically arranged. A sequel for the years 1858—70 was issued by Ruprecht in 1872.

Wurtz, Adolphe. *Sur quelques Points de Philosophie Chimique. Lecons professées les* 6 *et* 20 *Mars* 1863, *devant la Société Chimique* [*de Paris*] *par M. Adolphe Wurtz, Président de la Société.* 8vo. Paris, 1864.

An admirable discussion of the development and principles of modern chemical philosophy.

Deherain, P. P. *Etudes pour servir a l'histoire de la Chimie* [*Extrait des Annales du Conservatoire impérial des arts et metiers*]. 8vo. Paris, 1864.

Silvestri, Orazio. *Il presente ed il passato della chimica considerata nei suoi rapporti con le altre scienze naturali.* 16mo. Catania, 1864.

(To be continued.)

Reduction of Aldehyds to Alcohols.—Carl Schorlemmer.—The author dissolves œnanthic aldehyd in strong acetic acid, and adds gradually to the cooled solution liquid sodium-amalgam, until a deposit of acetate of soda took place. A sufficiency of water was added, the lighter stratum of liquid which rose to the surface was removed, again dissolved in acetic acid and treated with amalgam, till the pungent odour of œnanthic oil was no longer perceptible. The crude product, which evidently contained acetate of heptyl, was left for a time in contact with caustic potash, and then distilled. The distillate was dehydrated as far as possible with ignited potash and repeatedly rectified over small quantities of sodium. A good yield of pure heptylic alcohol was thus obtained.—*Liebig's Annalen.*

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SOCIETY OF PUBLIC ANALYSTS.

THE SALE OF FOOD AND DRUGS BILL.

On May 28th last, this Bill having passed its third reading in the House of Commons, we reprinted its more important clauses and italicised the very numerous alterations which they had undergone in the passage of the Bill through its various stages in the Lower House.

More than two months have elapsed, and we are approaching the end of the session, and still the Bill has not become an Act of Parliament.

The House of Lords have, however, considerably amended it, and their alterations, which it is only fair to admit bear the mark of thoughtful consideration, have been agreed to, all save one, by the Commons.

It is therefore only this one, concerning clause 6, which stops the way.

The measure having arrived so nearly at completion, we will briefly direct attention to the amendments to which both Lords and Commons have agreed.

In clauses 3 and 4 the word "knowingly" is struck out, and thus at last this obnoxious word has no place in the Bill at all. However, to prevent any injustice being done to an honest and reasonably careful tradesman, the following is introduced as an addendum to clause 4:—

Provided that no person shall be liable to be convicted under either of the two last foregoing sections of this Act in respect of the sale of any article of food, or of any drug, if he shows to the satisfaction of the justice or court before whom he is charged that he did not know of the article of food or drug sold by him being so mixed, coloured, stained, or powdered, as in either of those sections mentioned, and that he could not with reasonable diligence have obtained that knowledge.

Clause 5, which has given rise to so much discussion, has been again recast, and now stands—

No person shall sell to the prejudice of the purchaser any article of food or any drug which is not of the nature, substance, and quality of the article demanded by such purchaser, under a penalty not exceeding twenty pounds; provided that an offence shall not be deemed to be committed under this section in the following cases; that is to say,

(1). Where any matter or ingredient not injurious to health has been added to the food or drug because the same is required for the production or preparation thereof as an article of commerce, in a state fit for carriage or consumption, and not fraudulently to increase the bulk, weight, or measure of the food or drug, or conceal the inferior quality thereof;

(2). Where the drug or food is a proprietary medicine, or is the subject of a patent in force, and is supplied in the state required by the specification of the patent;

(3). Where the food or drug is compounded as in this Act mentioned;

(4). Where the food or drug is unavoidably mixed with some extraneous matter in the process of collection or preparation.

Clause 7 is made a shade more stringent by providing that the admixture allowable in the presence of a label shall not only be "not intended fraudulently to increase its bulk, weight, or measure," but must not be intended to "conceal the inferior quality" of the article. There are some minor alterations in this clause to which it is needless to refer.

In clause 11 it was already provided that "any purchaser" might, if there were no analyst appointed for the district in which the purchase was made, take the article "to the analyst of another place," but in clause 12, referring to the action of "medical officers, inspectors, &c.," no provision was made for the analysis of any articles purchased by them except by "the analyst of the district."

This is now amended, and where there is no appointed analyst, any inspector, &c., may take samples to the "analyst of another place," and "such analyst shall, upon receiving payment as is provided in the last section (*i.e.*, by special arrangement), analyse the same," &c.

In clause 18, which refers to the analysts' quarterly reports, the word "presented" is substituted for "read." This alteration bears this significance, that hitherto it has been imperative for the report to be "read," and consequently if an analyst had to deal with a stupid or a prejudiced Board, he was not entirely at their mercy, inasmuch as it was out of their power to strangle his report by merely ordering it to be "laid on the table."

This, it appears, they can now do, but there is this compensating advantage, that every such local authority is now bound to transmit annually to the Local Government Board, *not* a copy "of the number of articles analysed," but of "*such quarterly report.*"

In clause 21 is an important addition.

It was therein provided that "the justices before whom any complaint may be made," might send an article to be analysed to Somerset House, but no such power was given in any case of appeal. This was manifestly an omission, which is now supplied, and the same power is given to "the court before whom any appeal may be heard."

The phraseology of clause 24 has been remodelled to suit their lordships, but as the sense remains substantially the same, that is of little consequence.

The following addendum to clause 27 is of immense importance to the retailer who has been treated unfairly by the wholesale dealer who has supplied him, and deserves to be carefully read by all, if only to illustrate the painstaking care which the House of Lords have given to the Bill.

"Provided that in any action brought by any person for a breach of contract on the sale of any article of food or of any drug, such person may recover alone or in addition to any other damages recoverable by him the amount of any penalty in which he may have been convicted under this Act, together with the costs paid by him upon such conviction, and those incurred by him in and about his defence thereto, if he prove that the article or drug the subject of such conviction was sold to him as and for an article or drug of the same nature, substance, and quality as that which was demanded of him, and that he purchased it not knowing it to be otherwise, and afterwards sold it in the same state in which he purchased it; the defendant in such action being nevertheless at liberty to prove that the conviction was wrongful, or that the amount of costs awarded or claimed was unreasonable."

There are numerous other amendments to which both houses have agreed, but as they are of scant interest to analysts, and as it may reasonably be hoped that the Act itself will be published ere long, we do not propose to allude to them here.

It therefore only remains for us to refer to the one clause (6) upon which the two houses are at variance. The clause, as it left the House of Commons, is before our readers.

The Lords proposed to cut it down to the following dimensions:—"No person shall sell any compound article of food or compounded drug which is not composed of ingredients in accordance with the demand of the purchaser, under a penalty of twenty pounds."

To this the Lower House object, and submit as an alternative proposal, the following, which is substantially a restoration of the clause to its original form:—

"No person shall sell any compound article of food or compounded drug which is not compounded of ingredients in accordance with the demand of the purchaser, or in the case of a drug which is not compounded in accordance with the prescription presented by the purchaser, or with

the prescription of a registered medical practitioner, or with the regulations prescribed by the British Pharmacopœia issued by the General Medical Council, or in Great Britain with a basis to be laid down by the Council of Pharmaceutical Society of Great Britain, or the Privy Council, or in accordance with the provisions of the Pharmacy Act, 1868, or in Ireland in accordance with the Act of the session of the thirty-third and thirty-fourth of Victoria, chapter twenty-six, under a penalty not exceeding twenty pounds."

The Peers, however, on the motion of the Duke of Richmond, on the 3rd instant, decided to "disagree" to the Commons' amendment, and have appointed a Committee to draw up reasons for their disagreement; and so at present the matter stands, and whichever House eventuallly gives way one reflection will occur to all anxious to see the Bill become Law, in view of the speedy termination of the Session, that, whatever is to be done, "'t were well 't were done quickly."

We have now laid before our readers all the changes of any moment made in the Bill up to the present date, and these read side by side with the abstract (CHEMICAL NEWS, vol. xxxi., p. 235) will enable them to see exactly what the Bill is: they will therefore be able to form their own conclusions as to its value, or otherwise, for the purpose for which it is intended.

Any opinions of our own we will reserve for a future occasion, when we hope we may be able to speak of the measure as an accomplished fact.

NOTICES OF BOOKS.

Pyrology, or Fire Chemistry. By W. A. Ross. London: E. and F. N. Spon.

OUR readers will remember that in 1868 there appeared in the CHEMICAL NEWS a series of papers on Blowpipe Analysis, by Major Ross, at that time a resident in India. These articles form the nucleus of the present volume,—a work which we have no hesitation in pronouncing original and valuable. The author, as will at once be evident, is not a chemist trained in the orthodox school, outside of which there is no salvation. For cooked results and unproved theories he shows very little respect, and if he were brought up for examination at South Kensington we fear his "passing" would be by no means a matter of certainty. But this lack of normal chemical discipline, if it occasionally betrays him into errors, is far from being an unmixed source of weakness. It is an advantage to the world of science occasionally to hear the observations of one who approaches his subject by an unwonted route, and who, therefore sees it from a novel point of view. It is evident that the author is a careful, laborious, and patient experimentalist, and that he has a fruitful and suggestive mind. Now, in our humble opinion, the man who can originate even the smallest addition to our stock of knowledge is vastly superior to the "walking encyclopædia."

In his preface, the author questions the alleged simplicity of the supposed elementary bodies. In this view he is, it must be admitted, supported by the general tendency of modern science. Does it not seem, to say the least, highly probable that the doctrine of Evolution applies to chemical no less than to zoological species? He considers hydrogen as the principle of all metals, which, he adds, would furnish "a new and most interesting key with which to attempt to unlock the yet unexplained secrets of electricity, magnetism, and some spectral phenomena." He calls in question the accuracy of certain atomic weights, pointing out that such elements as cerium and didymium have never been perfectly isolated.

Incidentally he denounces the patent-laws, remarking that had he "lived under any other than the English patent law, which recognises unprincipled improvements rather than original inventions," he would have patented the practical applications of certain of his discoveries But how if he had lived in Holland or Switzerland, which grant no patents at all; or in Germany, where the case is substantially little better, and where the adoption of the English system—with all its admitted defects—is craved by inventors?

The main subject of the work—"pyrology," or "fire-chemistry"—is somewhat wider than what is ordinarily understood by blowpipe analysis. It may be considered as the minute study of chemical reactions produced in the "dry way." It can scarcely, we think, be disputed that this mode of research and this phase of chemistry have been too much overlooked, and that we have almost exclusively taken into account reactions obtained in the "wet way." The recent revelations obtained by the spectroscope are leading many chemists to question the propriety of this one-sidedness.

Our author gives, as Introduction, an interesting survey of the history of blowpipe analysis. He is, however, in error in supposing that since the time of Wollaston little or nothing has been done in England to improve or develop this mode of chemical research. In the CHEMICAL NEWS for instance, may be found certain original communications on this subject, by Mr. David Forbes, which we fee sure Major Ross would not pronounce valueless.

In a subsequent portion of the work the author remarks that the volatility of silver at high temperatures is not unknown in Germany. We can assure him that among assayers and metallurgists it is not unknown in England also. It is, however, remarkable how long a fact may remain in the hands of some particular class of practical men before it is recognised in standard works. For instance, potash and soda rejoice in the name of fixed alkalies; yet all soap-makers know that their lyes give off a well-marked odour by which they can be at once distinguished from solutions of the corresponding carbonates. Books tell us that carbonate of soda cannot be, like carbonate of lime, decomposed by heat; yet it is well known in alkali-works that soda-ash, heated too strongly or too long, loses a portion of its carbonic acid, and is partially causticised.

Among the principal improvements of which Major Ross claims the authorship are—the use of aluminium for supports in testing with the blowpipe, the vesiculation of borax with oxides dissolved in it, the vesiculation of boric acid, and the use of phosphoric acid as a reagent under novel circumstances.

It is obviously impossible for us to enter into an examination of all the author's methods and procedures; but we can imagine few courses of research more beneficial for a young chemist than to take up this work, and go carefully through the experiments laid down, and a few at least of the multitudinous collateral issues which they evidently raise. The least merit which belongs to Major Ross is that he has extended and improved the value of the blowpipe as a means of chemical and mineralogical research: possibly it may be found that he has done much more.

As an instance of the valuable facts which the author brings forward incidentally, we may take the following, which surely will be found of interest not in scientific circles alone:—"The *soi disant* mortar taken by myself from between the bricks of the Agra Barrack was supplied by a native contractor to the Department of Public Works of the Indian Government, and is made—or said to be made—from the Kunkur, with which the whole district abounds. The reactions show that this substance is little better than mud, with a small quantity (perhaps 8 or 9 per cent) of lime and magnesia. The costly building from which this composition was taken is not yet one of the many Indian public buildings which have been ordered to be "abandoned" by the Government, lest they should fall on the heads of troops and others, some having actually fallen, and one at Allahabad—from the mortar of which just 5 per cent of lime was obtained by a Calcutta chemist, at

the request of the late Lord Mayo—fell and killed five or six people. It has been publicly stated in India, without denial, that the Indian Government has lost £40,000,000 by abandoned or ruined public bulldings built of Kunkur mortar in the last ten years, though, on the other hand, it appears to produce a fair hydraulic cement." Would not our authorities find that to obtain good chemical advice—we do not mean *gratuitously*, as they sometimes attempt—would be the truest economy?

We can strongly recommend this book to analysts, assayers, mineralogists, and to all persons interested in mining and metallurgy; and we trust the author will feel encouraged to persevere in researches which must ultimately prove fruitful.

The Retrospect of Medicine. Edited by W. Braithwaite, M.D., and Jas. Braithwaite, M.D. Vol. lxxi., Jan.—June, 1875. London: Simpkin, Marshall, and Co.

This half-yearly repertory, invaluable as it must be to the medical profession, contains but little matter of a strictly chemical nature. We find iodic acid recommended as a very delicate colour test for the presence of strychnia. When a saturated solution of iodic acid is gently warmed in contact with strychnia a pink-rose tint is evolved, which lasts for an hour or more, and gradually fades out through flesh-colour to a fawn.

Molybdic acid dissolved in pure sulphuric acid is proposed as a test for opium. It forms in contact with any liquid in which morphia is present a deep maroon colour, which after a time becomes a deep purple, and then changes first to a darker and ultimately to a bright blue. This blue colour remains perceptible for some hours before it fades away. The reaction is distinct with a single drop of the pharmacopœal tinct. opii. The reagent is most sensitive when freshly prepared; still two months after it was made it enabled Dr. Southey to detect the $\frac{1}{50}$th of a grain of morphia.

In an interesting paper Dr. Odling contends that the so-called malarial diseases are due not to any specific poison, but to cold or chill after exposure to great heat, especially if it has been accompanied with severe fatigue.

Manual of Determinative Mineralogy, with an Introduction on Blowpipe Analysis. By G. J. Brush. New York: John Wiley and Sons. London: Trübner and Co.

This book consists of two portions. The former portion treats on blowpipe analysis, and is avowedly based on the works of Berzelius and Plattner. As such we need scarcely say that the methods laid down for the determination of minerals are excellent. When we remember, however, that there are at least three reversions of Prof. Plattner's great work in the English language, one of which—that by Prof. H. B. Cornwall—leaves scarcely anything to desire, we cannot help feeling somewhat doubtful as to the *raison d'etre* of this section of the work before us.

The second portion of Mr. Brush's book is a translation of von Kobell's well known *Tafeln zur Bestimmung der Mineralien*, with the addition of new species, and of alterations in form, which the author hopes will greatly facilitate the work of the student.

The appearance of the work is a fresh proof, if such is needed, of the great and increasing attention given in the United States to mineralogy.

Bulletin of the Bussey Institution. Part III., 1874. Cambridge: J. Wilson and Son.

This issue contains three interesting articles, all from the pen of Professor F. H. Storer. The first of these treats on the valuation of the soluble phosphoric acid in superphosphate. This the author fixes at somewhat under 12½ cents gold per lb., a point rather below the English tandard. It is, indeed, becoming somewhat doubtful whether the chemist has, strictly speaking, anything whatever to do with the valuation of manures. If there is only one standard of value—the purely commercial depending, of course, on supply and demand—we should pronounce that he has not. But it has been generally considered that there exists also a second standard of value totally unaffected by supply and demand, and depending on its power to nourish vegetation. This second ought to be higher than the commercial value; and it is with the former alone that the chemist can concern himself. The paper on the "Average Amount of Potash and Phosphoric Acid in Wood Ashes" will have a permanent value as containing very copious and carefully compiled tables of the saline constituents of woods, barks, leaves, &c.

In the paper on the "Importance as Plant-Food of the Nitrogen in Vegetable Mould," Professor Storer comes to the conclusion that, "for the present support of agricultural crops, the vast stores of vegetable mould that have accumulated in the soil through the decay of many generations of plants, constitute a more abundant and a more important source of nitrogenised plant-food than any other.

CORRESPONDENCE.

THE MILK QUESTION.

To the Editor of the Chemical News.

Sir,—While there is so much discussion going on in your columns in regard to the analysis of milk and the punishment of vendors (sometimes by very trivial fines—*vide* Chemical News, vol. xxxii., p. 7), you may be willing to print the result of three recent complaints made by the Milk Inspector here, who bases his action upon my analysis. Bills were found by the grand jury against three milk vendors, and, each pleading guilty, two were fined 300 dollars and costs apiece (say, £60), and the third, for a first offence, 30 dollars and costs, or about £6 sterling. The percentages of solids not fat were, respectively, 6·35, 6·57, and 7·0.—I am, &c.,

J. M. Merrick.

59, Broad Street, Boston, Mass., U.S.A.,
July 17, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, tome lxxxi., No. 1, July 5, 1875.

Distribution of Magnetism in Bundles of Infinite Length Composed of very Slender Laminæ.—M. J. Jamin.—It is demonstated that, in superposing laminæ in any number and in any direction, the bundle contains the algebraic sum of the magnetisms of its elements; but this is only true when the bundle is so long that it may be considered infinite.

Second Note on Tubular Electro-Magnets with Multiple Nuclei.—Th. du Moncel.—Not adapted for abstraction.

Protosulphide of Carbon.—M. Sidot.—The author makes known the continuation of his researches on the decomposition of bisulphide of carbon under the influence of solar light. In a memoir presented to the Academy, January 15, 1872, he mentioned that the bisulphide of

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carbon was decomposed on exposure to light, giving rise to a gas, and a red flocculent matter. On collecting a larger quantity of these products, he finds the gas to be merely air; and on taking due precautions to prevent its entrance into the apparatus, he effected the decomposition of sulphide of carbon without the production of a gas, obtaining sulphur, which remained in solution, and a brown matter, which was precipitated. The process was conducted in U-tubes, of 1 metre in length by 0·015 metre in diameter, one of the limbs being surmounted by a capillary delivery tube, and the other by a straight gas tube, both closed at the lamp. The light was allowed to act upon these tubes for about two months. At the end of this time the operation seemed terminated, the action of the light becoming more feeble as the layer of matter became thicker. The liquid contained in the tubes was filtered, and then distilled, when there remained in the retort crystalline sulphur, coloured a reddish brown by a little dissolved protosulphide. As for the precipitated matter, it remained attached to the interior of the tubes, from which it was removed by washing with distilled water. The weight of this matter, when purified, is to that of the residual sulphur as 3 to 4, that is to say, in the ratio of 1 equivalent sulphur to 1 equivalent of protosulphide of carbon. On analysis it was found that this compound is really the protosulphide, SC, resulting from the dissociation of CS_2 into CS and S. The protosulphide of carbon is a maroon powder, tasteless, and inodorous. Its specific gravity is 1·66. It is insoluble in water and alcohol, oil of turpentine, and benzol. In bisulphide of carbon and ether, both at a boil, it dissolves in very small quantities. Boiling nitric acid dissolves it, and turns red; the monohydrated acid poured upon the protosulphide of carbon in a stoppered tube, ignites it, and takes a deep brown colour. Sulphuric and hydrochloric acid do not appear to attack it. Potash, concentrated and boiling, dissolves it with a black-brown colour, but if the solution is neutralised with an acid the liquid is decolourised, and the protosulphide is liberated in flocks. If heated to about 200°, it begins to decompose into sulphur, which escapes, and carbon, which remains. In this decomposition there is always produced a little bisulphide resulting from the reaction of the liberated sulphur upon undecomposed portions of protosulphide. On heating protosulphide with excess of sulphur the synthesis of the bisulphide was effected. The author is studying the compounds resulting from the action of chlorine, bromine, and iodine upon the protosulphide of carbon.

Processes of Magnetisation.—J. M. Gaugain.—The author arrives at the general conclusion that if the angle formed by the magnet and the bar is made to vary from zero to 180° the magnetisation increases with the size of the angle. This law, however, does not hold good when the angle formed by the magnet and the bar exceeds 90°. It then decreases till a certain limit has been passed, which, in the author's experiments, was near 120°.

Nuts of Bancoul.—M. B. Corenwinder.—This nut is the seed of a tree belonging to the *Euphorbiaceæ*, of which two or three species occur in Ceylon, Cochin-China, New Caledonia, Bourbon, &c. It is composed of a hard and woody endocarp, and of an oily kernel, containing—

Water	5·000
Oil	62·175
Nitrogenous matter	22·653
Non-nitrogenous matter	6·827
Mineral matter	3·345
	100·000

Nitrogen 3·625 per cent.

The cake, after expression of the oil, contains 9 per cent of nitrogen and 4 per cent of phosphoric acid, and is consequently of high value as a manure. The expressed oil is purgative, but as a lamp-oil it is superior to colza. Unfortunately the kernel forms only 33 per cent of the entire weight of the nut. Hence, before it can become an article of commerce, it must be decorticated at the place of its growth.

Gum of Wine, and its Influence upon the Determination of Glucose.—M. G. Chancel.—For a considerable time it has been known that, besides glucose, wine contains other substances, optically active, and capable of reducing the cupro-potassic reagent. M. Pasteur, ten years ago, extracted from wine a substance which he described as a kind of gum. Recently Béchamp (*Comptes Rendus*, lxxx., p. 967) announced that he had isolated two bodies, A and B, capable of reducing the reagent of Frommherz. The author considers that the gum of M. Pasteur is identical with the substance A of M. Béchamp, and with the reducing substance of Neubauer, Hoppe-Seyler, Schubert, &c.

Chlorobromated Ethylen: Isomerism of its Chloride with the Bromide of Perchlorated Ethylen.—M. E. Bourgoin.—On causing chlorine to react upon the perbromide of acetylen the author has discovered a crystalline body, which he proposes to call chloride of chloro-bromated ethylen. It has the same composition as the bromide of chlorethose or the bromide of perchlorated ethylen. The author considers these compounds as isomeric, not identical, and represents the composition of the bromide of chlorethose by $C_4Cl_4(Br_2)$

Justus Liebig's Annalen der Chemie, June 25, 1875.

Determination of Phosphorous Acid, and on the Composition of the Phosphite of Baryta.—A. Prinzhorn and H. Precht.—Communicated by K. Kraut.—Phosphorous acid can be very conveniently and accurately determined by means of mercuric chloride. The phosphite is dissolved in hydrochloric acid, an excess of the chloride is added, and the whole is heated in the water-bath till mercurous chloride is rapidly and completely deposited, for which about two hours are requisite. When the filtrate no longer becomes turbid, even at a full boil over the open flame, the deposit is collected upon a tared filter, dried at 100°, and weighed. If the filtrate is then freed from mercury by the passage of sulphuretted hydrogen, and from other bases which interfere with the determination of phosphoric acid, the latter may be thrown down with magnesia-mixture, thus furnishing a way of checking the result. The authors are engaged with an investigation of the phosphites.

Decomposition of Certain Compounds of the Aromatic Series by Chlorate of Potash and Hydrochloric Acid.—Dr. Jos. Schreder.—The author examines the action of this mixture upon gallic acid, salicylic acid, and phenol, and finds among the results iso-tri-chlor-glyceric acid, a circumstance evidently connected with the very interesting fact observed by Linnemann and Zotta, that under certain circumstances glycerin can be converted into phenol.*

Improved Forms of Water-Air Pumps.—Edouard Linnemann.—This important paper is not intelligible without the accompanying illustrations.

Grove's Method of Preparing Chloride of Ethyl and its Homologues.—C. Schorlemmer.—The excellent method of preparing the chlorides of ethyl and methyl is not suitable for obtaining their higher homologues.

Investigations on the Paraffins of Pennsylvanian Petroleum.—T. M. Morgan.—A translation of an inaugural dissertation for the Dalton scholarship, Owens College, Manchester.

Remarks on the foregoing Paper.—Carl Schorlemmer.—The author considers that Morgan's results do not necessarily prove the presence of three heptanes in petroleum.

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* *Liebig's Annalen*, Supplement Band viii., 254.

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Action of Mineral Acids upon Chloride of Lime.—Ferdinand Kopfer.—The author considers it simplest to regard hypochlorous acid as a direct product of the decomposition of chloride of lime by mineral acids. Either Gay-Lussac's hypothesis on the constitution of the bleaching constituent in chloride of lime must be accepted, or that of Odling, but to which the preference belongs he has not been able to determine.

On Arbutin.—H. Hlasiwetz and J. Habermann.—Not suited for abstraction.

Occurrence of Ethylic Alcohol or its Ethers in the Vegetable Kingdom.—Dr. H. Gutzeit.—This paper proves the occurrence of ethylic alcohol in unfermented vegetable juices, *i.e.*, those of the fruits of *Heracleum giganteum* and *Pastinaca sativa*. In the juice of a third plant, *Anthriscus cerifolium*, the existence of ethyl compounds is also demonstrated, but it is not yet decided whether such occur in the state of alcohol or of ethers.

Bulletin de la Societe Chimique de Paris, No. 1, July 5, 1875.

Second Memoir on Albumen and Proteic Bodies.—M. Schützenberger.—The author examines the constitution of the amidised bodies corresponding to leucin and its homologues, the existence of which he had established in a former paper. (*Bul. Soc. Chim.*, tome xxiii., p. 161).

On Camphenes.—M. J. Ribau.

Isomerism of the Hydrochlorates, $C_{10}H_{16}HCl$.—M. J. Ribau.

Transformation of the Camphor of the Laurineæ into Camphene, and Reciprocally of Camphenes into Camphor.—M. J. Ribau.

New Method of Preparing Highly-Concentrated Formic Acid by means of Dehydrated Oxalic Acid, and of a Polyatomic Alcohol.—M. Lorin.

The above four papers have been already noticed.

Action of Chlorine upon Isobutyl-hydriodic Ether.—M. Prunier.—The substitution of chlorine in this compound appears to furnish a complete series of chlorinised bodies from C_8H_9Cl to $C_8H_4Cl_6$, $C_8H_2Cl_8$, and even beyond.

Les Mondes, Revue Hebdomadaire des Sciences, No. 9, July 1, 1875.

M. Moigno announces a work of his own under the title of "Faith and Science: Explosion of Free Thought in August and September, 1874: Annotated Discourses of MM. Tyndall, Du Bois-Reymond, Richard Owen, Huxley, Hooker, and Sir J. Lubbock." In his introductory remarks he terms himself the "advanced sentinel of truth," and states—"I have effected in myself the perfect conciliation of Faith and Science. I have studied more than all the champions of free thought. I have great confidence in the enlightenment which this modest work will produce."

The issue contains no chemical or physical matter which we have not already noticed.

No. 10, July 8, 1875.

Preservation of Meat in Compressed Air or Oxygen.—M. Moigno maintains that in this process M. Bert had been anticipated by Alvaro Reynoso.

Tempered Glass.—E. Girouard.—Articles of tempered glass sometimes burst into a multitude of fragments if struck very slightly. This happens chiefly when they have undergone a molecular modification by the action of a great number of previous shocks or blows. The author thinks that the process of tempering may be also applicable to enamel, earthenware, &c. (As regards the novelty of tempering glass, it is interesting to observe that it was customary in the north of England, in the last century, to place newly-purchased glasses, cups, &c., in a pan of cold water, which was then very gradually raised to a boil, with the idea that they were thus rendered less brittle.)

Congelation of Water by Capillarity and Evaporation.—C. Decharme.—An account of experiments undertaken to freeze water by taking advantage of the volatility of bisulphide of carbon, ether, &c.

Seventh Bulletin of Osmose.—A paper on sugar refining.

Temperatures of Combustion in the Open Air.—H. Valerius.—A reply to a paper by M. Vicaire, contained in *Les Mondes* for May 20, on the exactitude of the law of Bunsen, according to which oxygen and combustible bodies can only combine in proportions which vary abruptly at certain changes of temperature.

Gazzetta Chimica Italiana, Anno v., 1875, Fasc. iv.

On the Hydrate of Chlorine.—Ugo Schiff.—The compound Cl_2+10H_2O, in its property of hydrate of a chemical element, occupies an entirely special position in the chemical system. Gœpner has recently investigated this compound (*Berichte*, viii., p. 287), and cites U. Schiff as the author of the view which regards it as—

$$ClHO+HCl+9H_2O.$$

M. Schiff does not remember having ever published such a view, which is of a much more ancient date. He points out that hypochlorous acid is an explosive compound, whilst the hydrate in question shows no tendency of this kind, not even when thrown into concentrated sulphuric acid somewhat heated.

Action of Aniline upon Dichlorhydrin.—Ugo Schiff—Already noticed.

Supposed Transformation of the Asparagin of the Leguminosæ into an Albumenoid.—M. Mercadante.—The author concludes that asparagin formed during the germination of seeds is decomposed, ammonia being especially found among the products of decomposition. It cannot be admitted that asparagin is transformed into albumenoids under the influence of light, and of carbonic acid. Light, instead of converting asparagin into albumen, decomposes it, yielding aspartic and succinic acids.

Tincture of Litmus.—F. Mohr.—To obtain a very sensitive tincture of litmus, the author super-saturates with sulphuric acid to decompose the carbonates, and then adds baryta-water until a blue colouration is produced—(*Zeitschrift fur Analytische Chemie*).

Phosphate of Chrome.—H. Kaemmerer.—An alkaline solution of chromic oxide containing phosphoric acid, deposits chromic oxide on boiling.

New Naphthaline Colour.—M. Ballo.—On heating naphthylamin and bromide of naphthalin, there is produced a liquid mass of a dark red by transmitted light, which if extracted with ether leaves a blue powder soluble in alcohol with a fine violet colour, and is the hydrobromate of a base, precipitable by ammonia in blue flocks.—(*Dingler's Journal*).

Fascicolo v.

Oxidation of Sulphur.—Prof. Egidio Polacci.—The principal results of the author's researches are that moist sulphur exposed to the air under ordinary conditions of temperature, although not associated with any other material, is easily converted into sulphuric acid. This conversion, slowest at low temperatures, is accelerated at + 35 to 50°, and becomes rapid at + 65 to 70°. The addition to the sulphur of carbonate of lime, but not that of other earthy carbonates, facilitates the production of sulphuric acid. Hydro-sulphuric acid, mixed with moist air in presence of a porous body, and at a moderately elevated temperature, is slowly converted into sulphuric acid. Even dry sulphur, by the mere contact of the air, if the latter is not deprived of its watery vapour, gives rise to sulphuric acid. In this case the amount of sulphuric acid formed will be in proportion to the absorbent power of the sulphur.

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MISCELLANEOUS.

Metallic Alloys.—We lately drew attention to the appointment of the United States Board for the purpose of testing iron, steel, and other metals. Prof. Thurston, the Chairman of the Committee on metallic alloys, has just issued a circular stating that a Committee of the Board has been instructed, during such time as may be found available pending the construction of the apparatus ordered by the Board for use in general work, and during such intervals as may subsequently be properly appropriated to such purpose, to investigate the mechanical, physical, and chemical properties of the alloys of the useful metals, and to determine if possible their interdependence and the laws governing the phenomena of combination and of their resistance to stress. The Committee desire to obtain records of all experiments which have hitherto been made in this direction, and to secure such exact information as may assist further researches. It is desirable that such records should embody a statement of the precise chemical constitution of each alloy examined, as obtained both by synthesis and subsequent analysis. Its specific gravity, specific heat, conductivity, its combining number, and the relation of its chemical constitution to the series of similar compounds produced by alloying the elements in the proportions of chemical equivalents, should be stated whenever possible. A few thoroughly well studied examples will be of more service than a large number of isolated determinations of single facts. It is further desired that the ultimate strength, the elastic limit, the modulus of elasticity, the ductility resilience, homogeneousness, hardness, and other mechanical properties of the specimen be ascertained and accurately stated. Where only a part of this work can be done by the investigator, this Committee is prepared to assume charge of the remaining portion of the research, when the alloy can be furnished in proper quantity and form. References to published accounts of similar works and monographs on any branch of the subject will be accepted. Special researches made for this Committee will be received with appropriate ackowledgments. The departments of physics and of chemistry in the various colleges and universities will probably be able to render valuable aid, and their cooperation is earnestly requested. The schools of engineering are in a position to assist this Committee very effectively, and their contributions will be thankfully accepted. Suitable blanks upon which to record the data offered, will be furnished upon application. Specimens of alloys for test by the Committee must be accompanied by a statement upon these blanks of their precise constitution, and such information as it is possible to give, with an account of such peculiarities as are known to distinguish the alloy, and of the special object which it is supposed may be attained by the investigation. Where possible, it is required that one or more specimens shall be furnished of each of the specified kinds, and of precisely the form and dimensions, which will be given on application.

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CONTENTS OF No. VI.

On the Changes of Temperature which occur in Passage of an Electric Current from One Metal to Another—Causes of Destruction to Wooden Posts, by M. Bourseul—Sir William Thomson's Method of Deep Sea Sounding by Pianoforte Wire—The Government Telegraphs—Correspondence—Notices of Books—Abstracts of all Memoirs which have appeared in Foreign Journals—Editorial Notes of Passing Events—Telegraph Share List—Patents, &c.

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VOL. XXXII. No. 821.

SOME FURTHER OBSERVATIONS ON THE SPECTRA OF LIGHTNING.

By J. W. CLARK.

About 10.30 in the evening of August the 8th (Sunday) a few flashes of *sheet* lightning were seen in the south, but nothing more was observed until 1.30 a.m. Monday morning, when, from a window facing the east, bright and frequent flashes were visible. The sky was partially clouded over, and the wind occasionally very high.

In a previous number of the CHEMICAL NEWS (vol. xxx., p. 28) are recorded the results of my previous observations on the spectrum of sheet lightning: the following confirm and extend them. The observations were made with one of Browning's hand spectroscopes. At first the slit was wide, but, as the flashes became more brilliant and more frequent, it was gradually narrowed, whilst leaving the spectrum sufficiently bright. Many of the flashes exhibited only the centre of the spectrum, which was of a bluish white colour, and varied slightly in length. With the most brilliant flashes, however, the red end of the spectrum was bright, whilst the middle and blue end (when present) was of the same bluish white colour throughout.

Shortly after 2 o'clock the sky became more clouded, and the sheet lightning was gradually succeeded by brilliant *forked* lightning, which, with a narrow slit, gave a very bright *continuous* spectrum of normal appearance.

On one occasion the red end of the spectrum appeared traversed with two or three red lines, and the green with a few atmospheric absorption lines in two other cases. These three observations are, however, not very reliable.

Towards the close of the storm, which accompanied the forked lightning, 0·395 of an inch of rain and hail fell* in about twenty-five minutes; but soon after 3 o'clock the sky was clear, but occasional appearances of sheet lightning were visible until nearly 4 o'clock.

That no lines should have been observed in the spectrum of the forked lightning, and no bands in that of the sheet lightning, is somewhat remarkable, as a large number of observations were made between 1.30 and 3 o'clock, during a considerable part of which time the flashes of lightning were so frequent as to be almost continuous, and a great many were of unusual brilliancy.

ANALYSIS OF THE SULPHUR WELL, BALLYNAHINCH SPA.†

By Dr. ANDREWS, F.R.S. L. & E.

The waters of the Ballynahinch Spa have enjoyed a local reputation for more than a century, and are still resorted to by visitors and invalids from Belfast and the surrounding district. No analysis, except an imperfect one by Sir R. Kane, has been published, so far as I know, of the Sulphur Well. The water examined by that able chemist must have been altered by keeping, as no mention is made in the analysis of any of the constituents upon which the active properties of the water depend. The following analysis refers to the Sulphur or Lower Well, and was made so long ago as 1869. The temperature of the well, about 11 o'clock on July 21 of that year was 9·5° C., or 49·1° F. The amount of sulphides was carefully determined in the pump room by observing the quantity of water required to decolourise a standard solution of iodine. Portions of the water were taken at the same time for analysis in well closed and perfectly filled bottles. If care be taken to fill the bottle fully with water at the well, without leaving a bubble of air in it, and if the bottle is afterwards kept with the neck downwards and under water, the spa water may be preserved with little change for several weeks. But the presence of even a small quantity of air will cause the decomposition of the sulphides in a few hours, and deprive the water of its useful properties.

The following are the constituents in 1000 parts of the water of the Sulphur Well:—

Bicarbonate of calcium	0·1049
Bicarbonate of magnesium ..	0·0462
Sulphate of magnesium	0·0175
Chloride of magnesium	0·0037
Chloride of sodium	0·0165
Sulphide of potassium	0·0044
Sulphide of sodium	0·0012
Silica	0·0012
Organic matter	0·1040
Saline constituents	0·2996

The free gaseous constituents in 1000 volumes of the water are—

Sulphuretted hydrogen	3·55
Carbonic acid	70·00
Nitrogen	19·50

From the foregoing analysis it appears that the saline constituents in this water are insignificant, and that its active properties are due to the sulphides and carbonic acid contained in it. Of its value as a mild sulphur spring, I have no doubt whatever, and I shall be gratified if the publication of this analysis should draw attention to it.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 54.)

The more we must hope that the manufacture of oxygen may be saved by the metallurgical demand. In medicine it has not found any general application. According to Pereira,† in spite of certain modern eulogies of the healing power of oxygen, there is, in the opinion of competent judges,‡ little to be said on the subject. We quote the passage:—

"Soon after the discovery of oxygen gas, a strong feeling arose in favour of its medicinal applications. Various diseases, *e.g.*, scurvy, were ascribed to a deficiency of it in the system, and it was accordingly employed in many cases, and, as was at first declared, with brilliant results. In England, it was tried by Beddoes and Hill.‖ The latter declares that he found it useful in asthma, weakness, ulcers, gangrene, white swellings, and scrofulous affections of the bones. These views have been again abandoned, both on chemical and physiological grounds. In asphyxia, from want of air, or from the inspiration of pernicious gases, oxygen gas may be inhaled with advan-

* Recorded by the Meteorological Department of the Ordnance Survey Office, Southampton, not far from which these observations were made.

† From the *Proceedings of the Belfast Philosophical Society.*

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† Pereira, "Heil Mittel Lehre;" Buchheim's German edition, vol. i. p. 217.

‡ Verbal communication from Professor Oscar Liebreich.

‖ "Considerations on the Use of Factitious Air and on the Manner of Obtaining them in Large Quantities," by F. Beddoes and J. Watt; Bristol, 1794-95. It is well known that, in 1798, a Pneumatic Institute was founded at Bristol, in which the medicinal properties of gases were examined, and where Humphry Davy discovered the effects of nitrous oxide.

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tage. From the same reason, it has been recommended in spasmodic asthma attended with danger of suffocation. Still it is, at the best, a mere palliative, and can by no means prevent renewed attacks. If we consider, in the application of oxygen gas, its physical action, as already discussed, we shall readily conclude that the inspiration of oxygen is in most cases useless, and that but little—and only in few cases—can be expected from its therapeutical application.

Nevertheless, an "Inhalatorium," recently opened in Berlin, sells oxygen at 6 silver groschen per cubic foot (20 marks per cubic metre), and oxygenated water at 1½ silver groschen per bottle.* As water at 0° does not absorb 4 per cent of its volume, a half-litre bottle does not contain 20 c.c., or 0·0017 grm., of the gas! To expect any effect from such a dose appears irrational.

Just as concentrated food is recommended for travellers, so oxygen has been proposed to be inhaled by those who climb the highest summits of mountains or attain altitudes in balloons where the rarefaction of the atmosphere occasions dangerous affections.† P. Bert‡ has exposed himself and others, in a suitable apparatus, to dilutions of air far surpassing that encountered at the greatest altitudes hitherto reached. The difficulty of breathing and the symptoms of suffocation which appeared when the barometer indicated 300 to 250 m.m. were relieved, according to his account, by a single inspiration of pure oxygen. Dilution of oxygen with atmospheric air was found more advantageous than the pure gas; and on a balloon voyage which Croce-Spinelli and Sivel undertook from Paris, March 22nd, 1874, they took with them mixtures of 45 and 75 per cent of oxygen (and therefore 55 and 25 of nitrogen). With the aid of this mixture they were able to conduct valuable physical observations at leisure, and without bodily inconvenience, at the height of more than 6000 metres; and although Glaisher succeeded, without this auxiliary, in attaining still greater heights, it cannot be denied that oxygen gas affords the means of exploring atmospheric regions hitherto unknown.

The physiological applications of oxygen lead us naturally to that modification which bears the name of ozone, with which, in the outset, high therapeutical hopes were connected.

(To be continued.)

ON GLYCOGEN AND GLYCOCOLL IN THE MUSCULAR TISSUE OF PECTEN IRRADIANS.‖

By RUSSELL H. CHITTENDEN,
Assistant in Physiological Chemistry, Yale College.

The genus *Pecten* is world-wide in its distribution. The species *irradians* is entirely American, being found most abundantly on the eastern shores of the United States. It is closely allied to the European and English species *opercularis* and *maximus*. The large central muscle which closes the valves of this mollusc is highly valued as an article of food, although its peculiar sweet taste is objectionable to some. With this central muscle the following experiments were made:—

Glycogen.—By extracting the edible portion of the scollop with cold water, a milky opaque fluid with slight acid reaction is obtained, and an insoluble residue consisting principally of syntonin or fibrin mixed with inorganic matters. The strong opacity of the aqueous solution is not due to an emulsion of fatty matters. On boiling the solution with or without the addition of acetic acid, a large amount of albumen is precipitated, leaving the fluid still opalescent. On treating the fluid, after the removal of albumen, with a small amount of 95 per cent alcohol, a light flocculent precipitate is obtained which dissolves by agitation, leaving the fluid unaltered in appearance; but, if three or four volumes of the alcohol are added, a copious permanent precipitate settles, leaving the supernatant fluid perfectly clear. This precipitate is of snowy whiteness, except when previous to precipitation the fluid has been boiled considerably, in which case both filtrate and precipitate assume a yellow or brownish colour, from which the latter can be freed by solution in cold water and re-precipitation by alcohol. The precipitate, if allowed to dry in contact with air, after having been washed with alcohol merely, soon becomes translucent on the edges, and finally is transformed completely into a gummy mass which is sticky when moistened; but, if after precipitation it is washed with ether thoroughly, it loses this property of becoming gummy, which seems to be due to the presence of water and of albuminous matters in small quantity. This gum-like mass, when hard, is brittle, and yields, on trituration, a white hygroscopic powder showing under the microscope no distinct structure. A portion of the precipitate so prepared, dried in the air, yielded by analysis:—

	1.	2.	Calculated. $C_6H_{10}O_5+H_2O$ or $C_6H_{12}O_6$.
C	39·52	39·56	40·00
H	6·62	6·55	6·60
O	53·86	53·89	53·34

In this state it is not quite pure, giving with Millon's reagent a strong reaction for albumen, and containing some inorganic matter—one specimen 1·57 per cent, another 1·38 per cent—consisting in all cases, so far as were examined, of calcium phosphate. From this analysis it is seen that the substance has the formula of the sugars, or that of the starch group *plus* a molecule of water. The substance is tasteless, gummy when moistened, and gives an opaque fluid with water, seemingly a true solution, which passes unchanged through filter-paper and animal charcoal, and shows no particles under the microscope with a half-inch objective. When this aqueous solution is boiled, thin films separate, forming a scum on the top of the fluid, which goes into solution again as the liquid becomes cool. The substance is insoluble in alcohol and ether, has no reducing action with cupric sulphate and sodium hydroxide, but, when boiled with a few drops of dilute hydrochioric acid, gives a clear fluid which has strong reducing action. This same reaction takes place also with nitric and sulphuric acids, but not so readily as with the former. A portion of the substance was treated with a small quantity of saliva at the ordinary temperature and at 40° C., and in both cases the ptyalin acted immediately upon it and sugar was formed. Treated with a solution of iodine in potassium iodide, a brownish red or maroon colour was obtained. These and other reactions pointed to glycogen. It was yet to be ascertained whether the sugar formed by the action of acids and ferments was glucose, also to examine the action of boiling dilute nitric acid upon it, and to determine whether the different formulæ of glycogen could be obtained by drying it at different temperatures. A portion of the substance was then boiled with hydrochloric acid until alcohol produced no precipitate in a sample tested, the excess of acid removed by oxide of silver and the sugar obtained by evaporation. The product had all the properties of glucose, was intensely sweet, reduced alkaline solutions of copper and silver, and yielded Pettenkofer's reaction. Analysed, it gave the following result:—

	1.	2.	Calculated. $C_6H_{12}O_6+H_2O$.
C	36·15	36·17	36·36
H	6·82	6·88	7·07
O	57·03	56·59	56·57

By the action of boiling dilute nitric acid, oxalic acid was formed and separated. A different sample of the original substance, dried over sulphuric acid until a constant weight was obtained, yielded—

* Eight silver groschen = four-fifths of a shilling sterling.
† Fonvielle, "La Science en Ballon;" Paris, 1869.
‡ Bert, *Comptes Rendus*, 1874, p. 911.
‖ Communicated by the Author.

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	1.	2.
C	43·81	43·90
H	6·43	6·46
O	49·76	49·64

A sample dried at 100° C. gave, by analysis—

	1.	2.	Analysis of Starch Dried at 100° C. by Mulder.
C	43·86	43·89	43·86
H	6·41	6·38	6·28
O	49·73	49·73	—

A sample dried at 140° C.—

	1.	2.	Analysis of Starch Dried at 140° C. by Mulder.
C	44·32	44·40	44·47
H	6·38	6·41	6·28
O	49·30	49·19	—

On treating an aqueous solution of the substance at the ordinary temperature with an excess of a saturated solution of barium hydroxide, a heavy white precipitate was obtained, soluble in water, insoluble in baryta water and alcohol. This precipitate was dissolved in water, the baryta removed by a little dilute sulphuric acid in the cold, and then re-precipitated by an excess of alcohol.

Prepared thus, it seemed to have lost the property of becoming gummy so readily as before, and on examination was found to be completely free from albuminous matters, giving no reaction even with Millon's reagent, and also contained only 0·61 per cent of ash. The substance, dried at 100° C., gave, by analysis, the following result, agreeing closely with that of the preceding preparation dried at the same temperature :—

	1.	2.
C	43·93	43·91
H	6·45	6·40
O	49·62	49·69

Another sample, prepared in the same way, and dried between 110°—120° C., gave—

	1.	2.
C	43·56	43·63
H	6·71	6·71
O	49·73	49·66

Casting a backward glance, we see that the analysis of the air-dried substance corresponds with the formula $C_6H_{12}O_6$, that of the substance dried at 140° C. with $C_6H_{10}O_5$, which requires 44·44 C, 6·11 H. These results agree with glycogen, which in different states of hydration has been found to have the formulæ $C_6H_{10}O_5$, $C_6H_{12}O_6$, and $C_6H_{14}O_7$. But the results obtained by the analyses of the substance dried at 100° C. and 110°—120° C. do not agree closely with any of the above formulæ. The same is true of members of the starch group to which glycogen is closely related, and lately Dr. Nägeli* has published a paper in which he points out that the elementary composition of starch, dextrin, and "amylo-dextrin," dried at temperatures not exceeding 116°, agrees better with the formula $C_{36}H_{62}O_{31}$, which requires 43·63 C, 6·3 H, than with $C_6H_{10}O_5$, and that after exposure to a temperature of 140° C., when the composition corresponds to $C_6H_{10}O_5$, we probably do not deal with undecomposed starch. The analysis of amylo-dextrin by Nägeli (*loc. cit.*, p. 35), dried in a stream of hydrogen, at a temperature of 112° to 116° C., gave the following result :—

	1.	2.
C	43·58	43·85
H	6·86	6·58

A sample of dextrin dried at the same temperature gave Nägeli, as a mean of two analyses, C 43·52, H 6·78, in both cases agreeing closely with my analyses of glycogen dried at 110°—120° C. Thus this substance, which is without doubt glycogen, coincides in this respect with its neighbours, dextrin, amylo-dextrin, &c.

A sample of glycogen, prepared by the preceding methods and dissolved in water, on treatment with basic lead acetate, with the application of a gentle heat, yielded a heavy gelatinous precipitate, which, when filtered off by the aid of a pump and washed with water, was found to contain lead. Dried at 100° C., it gave, by analysis, the following result :—

	1.	2.
C	21·62	21·78
H	2·91	2·96
Pb	48·39	48·34
O	27·08	26·92

Since this result was obtained, I find that M. Bizio* has already discovered glycogen in some invertebrates. Among the molluscs, he found it in considerable quantity in the oyster.

With glycogen from these sources he prepared a lead compound by means of tribasic acetate of lead, and says its "analysis has given me the formula $C_{12}H_{18}PbO_{10}$," which requires—

C	27·22
H	3·40
Pb	39·13
O	30·24

It will be seen at once that my result does not agree with this formula. I therefore made some further lead precipitates from the same and other preparations of glycogen, and in these simply determined the lead as follows :—

Pb.	1st Prep.	2nd Prep.	3rd Prep.	4th Prep.
No. 1	48·39	53·63	51·45	50·27
No. 2	48·34	53·58	51·45	50·28

Some glycogen was also prepared from the liver of an ox by the usual method and dried at 100°. It yielded, by analysis :—

	1.	2.	Calculated. $C_{12}H_{22}O_{11}$.
C	41·87	41·90	42·11
H	6·35	6·38	6·43
O	51·78	51·72	51·46

A lead preparation made from this gave—

	1.	2.
Pb	61·99	61·94

These results indicate that the composition of the precipitate is not constant.

The amount of glycogen occurring in this muscular portion of the scollop is quite large; at one time, from 3 quarts 160 grms. were obtained; at another, 2 quarts yielded 70 grms.

Glycocoll.—On evaporating the alcoholic filtrate from the precipitated glycogen until quite concentrated, and adding neutral lead acetate, a heavy white precipitate is produced, which is a combination of inorganic matters with the lead. The excess of lead is then removed from the filtrate by hydrogen sulphide, and after concentration the liquid is decolourised by animal charcoal. On further evaporation, the fluid deposits white prismatic crystals. The crystals have a sweet taste, but, upon ignition with soda-lime, ammonia is evolved, evincing the presence of nitrogen, which at once separates it from the saccharine group. The crystals first obtained were not quite pure, but after treatment with animal charcoal and re-crystallisation gave, by analysis, a result corresponding to the composition of glycocoll. Two more distinct preparations were made, and gave, by analysis :—

	1st Prep.		2nd Prep.	3rd Prep.	Calculated. $C_2H_5O_2NH_2$
	1.	2.			
C ..	31·98	31·99	32·09	31·97	32·00
H ..	6·88	6·84	6·79	6·81	6·66
N ..	18·57	18·58	18·49	18·45	18·66
O ..	42·57	42·59	42·63	42·67	42·66

The impurities which seemed to be the most difficult to remove were colouring and inorganic matters. The

* "Beiträge zur Nähe ltniss der Stärke Gruppe." Dr. lter Nägeli. 187

* *Comptes Rendus*, lxx., 175. *Zeitschrift für Chemie*, 1867, 745.

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crystals were soluble in water and weak alcohol, insoluble in ether and absolute alcohol. An aqueous solution, when treated with sulphate of copper and sodium hydroxide, assumed an azure blue colour without separation of cuprous oxide on heating. The substance melted at about 180° C., then decomposed. With nitric acid, fine crystals corresponding to nitrate of glycocoll were obtained. These analyses and reactions identify the substance as glycocoll, which I believe has never before been found in nature.*

A preparation was now made in which the alcoholic filtrate from the precipitated glycogen was evaporated without the addition of any reagents, and here the same crystals were obtained mixed with a considerable quantity of inorganic matters and some dextrose.

The amount of glycocoll occurring in the tissue is small, although where two or three quarts of material are used a fine crop of crystals may be obtained.

The quantitative analysis of the edible or muscular portion of the scollop, as obtained at the market, is as follows:—

First Analysis.

	1.	2.
Water	79·60	79·66
Solids	20·40	20·34
Ash	1·26	1·26
Nitrogenous matters (=N×6·4)	15·68	15·68
Ether extract	0·33	0·28
Non-nitrogenous, by difference	3·13	3·12

Second Analysis.

	1.	2.
Water	80·25	80·25
Solids	19·75	19·75
Ash	1·24	1·22
Nitrogenous matters	15·04	15·04
Fatty matters	0·32	0·24
Non-nitrogenous matters	3·15	3·25

Total amount of nitrogen in the substance dried at 100° C.:—

	1.	2.
N.	11·35	11·37

The percentage of glycogen was determined in two separate quantities.

	1.		2.	
	1.	2.	1.	2.
Glycogen	2·43	2·40	1·98	2·19

The percentage of glycocoll was determined, but, owing to the inaccuracy of the method, can be considered only as an approximation to the truth.

	1.	2.	3.	4.
Glycocoll	0·46	0·68	0·71	0·39

The ash of the muscle consisted of the bases, soda, potash, magnesia, and lime; acids, chlorine, sulphuric and phosphoric.

In conclusion, I wish to express my obligations to Professor S. W. Johnson for advice freely given.

OUTLINES OF A BIBLIOGRAPHY OF THE HISTORY OF CHEMISTRY.†

By H. CARRINGTON BOLTON.

(Concluded from page 57).

POGGENDORFF, J. C. *Biographisch-literarisches Handwörterbuch zur Geschichte der exacten Wissenschaften, enthaltend Nachweisungen über Lebens-verhältnisse und Leistungen von Mathematikern, Astronomen, Physikern, Chemikern, Mineralogen, Geologen, u. s. w. aller Völker und Zeiten.* Lex 8vo. 2 vols. Leipzig, 1858—63.

Invaluable as a work of reference. Abounds in information concerning chemists of every age and nation.

HOEFER, FERDINAND. *La Chimie enseignée par la biographie de ses fondateurs, R. Boyle, Lavoisier, Priestley, Scheele, Davy, &c.* 12mo. Paris, 1865.

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A singular work, rather metaphysical than historical or chemical.

BUFF, HEINRICH LUDWIG. *Ein Blick auf die Geschichte der Chemie.* 8vo. Erlangen, 1866.

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A rather hasty though compendious history, including notices of living chemists and modern researches.

WURTZ, ADOLPHE. *Histoire des Doctrines Chimiques depuis Lavoisier jusqu' à nos jours.* 12mo. Paris, 1869.

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CHEVREUL, E. *Histoire des principales opinions que l'on a eues de la nature chimique des corps, de l'espèce chimique et de l'espèce vivante.* Atlas 4to. Paris, 1869.

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HOEFER, FERDINAND. *Histoire de la Physique et de la Chimie depuis les temps les plus reculés jusqu' à nos jours.* 12mo. Paris, 1872.

The latter portion relating to chemistry is mainly a condensation of Hoefer's larger work noticed above.

RUPRECHT, RUDOLPH. *Bibliotheca Chemica et Pharmaceutica. Alphabetisches Verzeichniss der auf dem Gebiete der reinen, pharmaceutischen physiologischen und technischen Chemie in den Jahren, 1858, bis Ende 1870, in Deutschland und im Auslande erschienenen Schriften.* 8vo. Göttingen, 1872.

A continuation of Zuchold's "Bibliotheca Chemica," similarly arranged but evidently collated with less care and completeness.

RODWELL, G. F. *The Birth of Chemistry;* in "Nature," Vols. VI. and VII., 1872—73.

A popular essay full of research, especially rich in the knowledge of the Egyptians. It embraces only the period prior to 1680.

Certain Property of Ferric Ortho-Phosphate.—Fausto Sestini.—The yellowish white precipitate thrown down from the solution of a ferric salt on the addition of any solution containing an ordinary phosphate, $Fe_2(PO_4)_2$, is generally stated to be insoluble in water and in acetic acid. The author finds, however, that it is not absolutely insoluble in acetic acid; that its solubility in acetic acid is not augmented by the presence of chloride of ammonium; and that cold water withdraws a portion of the phosphoric acid. By the action of boiling water the salt is decomposed, the phosphoric acid being, to a great extent, dissolved, and the iron remaining as an insoluble basic phosphate.—*Gazzetta Chemica Italiana.*

* "Lehrbuch der Physiologischen Chemie, Gorup-Besanez," p. 236. 1875.

† From the *Annals of the Lyceum of Natural History, N. Y.*, vol. x.

SOCIETY OF PUBLIC ANALYSTS.

IMPROVEMENTS IN BUTTER ANALYSIS.*

By ARTHUR ANGELL, F.R.M.S.

The saponification of fats and the estimation of fixed fatty acids, after the subsequent decomposition of the soap, as applied to the estimation of foreign fats in the butters of commerce, was the original conception of my friend and colleague, Mr. Otto Hehner, assistant to Dr. Hassall; the matter was, however, worked at for months by myself in conjunction with him, before we ventured to make public the results of our researches. My friend Mr. George Turner, of Portsmouth, has improved the method, and rendered it more valuable by shortening the time needed, without jeopardising the accuracy of the results obtained.

The whole process, in the case where the percentage of every constituent of a fatty compound is required, may be conveniently considered under the three following heads, for each of which a separate part of the sample is required.

I. Microscopic examination.
II. Determination of water, fat, casein, and salt.
III. Determination of the point of fusion, and estimation of fixed fatty acids.

I propose to say nothing about the methods for the estimation of water, salts, &c., they being well understood by all, and the taking of the point of fusion has already been treated with here on another occasion; there is therefore only the microscopic examination and the estimation of fixed fatty acids to be dealt with.

In butter analysis it is dangerous to rely implicitly upon microscopic appearances; the microscope, however, should not be entirely dispensed with, it frequently affords valuable corroborative evidence.

In no case does any fat in the raw state show traces of crystals; on the contrary, when a fat is fused the membrane is broken up, and all the constituents are melted into an oily liquid, from which, on cooling slowly, the stearin and palmitin partly crystallise out. Beef, mutton, and pork fat in the raw state show large cells of adipose tissue, the contents of which depolarise light in an irregular manner.

Pure butter has no effect upon polarised light except when it has been heated and allowed to cool again; when cooled very rapidly no perfect crystals are formed, but the mass has a slight depolarising power which it did not possess when in the virgin or raw state.

If, therefore, upon pressing a small portion of the sample into a thin layer, and viewing it by polarised light, it shows stellate masses of crystals, it is a proof that some part of the fat has been melted down; and if no definite crystalline forms can be made out, but some portions or the whole of the mass possess any power over the polarised ray, it is probable that an animal fat in the raw state has been crushed and added in the cold. It must not be forgotten that it is quite possible that in the summer time the outside portion of a pure butter may have become fused and crystalline.

Thus far, and no farther, as it seems to me, can the microscope assist us in this matter, but even such indications are valuable, especially when subsequent analysis proves the sample to be an adulterated article, the microscopic evidence in such a case frequently helps to clench together the whole superstructure, and thus certainty is made doubly sure.

All fats being built up of the glycerides of the insoluble acids, stearic, oleic, and palmitic,—with in some cases the soluble, butyric, caproic, caprylic, and capric acids,—are capable of being saponified; that is to say, when treated with caustic alkalies glycerin is set free, and the base forms soluble salts with the acids, together producing a clear soap: upon the addition of a strong acid a new potash salt is formed, and the fatty acids are set free; those which are insoluble rise to the top in a foamy mass, which upon continued heating forms a clear stratum of fat, and are thus separated from the soluble acids and glycerin (which remain in solution).

By distillation we obtained 6 or 7 per cent of these soluble volatile constituents of butter, but could not get reliably constant results: that method was therefore abandoned, and their percentage determined by difference. The oily, fixed, fatty acids being caught upon a filter, washed, dried, and weighed, were found to give constant results.

The quantity of fatty acids obtained from twelve different samples of butter—quoted in "Butter, its Analysis and Adulterations"—varies from 85·40 to 86·20, showing a difference of 0·8 per cent. The average of our twelve samples of butter is 85·85 per cent of fixed acids.

The difference between the quantity of fatty acids found in butter and that found in other fats is therefore, on an average, 9·65 per cent.

Mixtures will yield quantities lying between 85·85 and 95·5 per cent. An adulteration of 100 per cent—that is, the substitution of any foreign fat for butter—would give a difference of 9·65 per cent: an adulteration of 10 per cent, therefore, would give a difference of 0·965 per cent. Each tenth of a percentage of fatty acids above the average figure would consequently be equal to 1·036 per cent of adulteration: it would, however, be unjustifiable to declare a sample of butter to be adulterated because the fatty acids lie three- or four-tenths of a percentage above the average figure. A difference of ½ per cent and above would, of course, constitute an adulteration.

To gain an idea of the accuracy to be obtained by our method, one of us prepared mixtures of foreign fat with butter, which the other analysed, without having an idea of the composition. The following results were obtained:—

Whole Butter.	Lard.	Foreign Fat, calculated from percentage of Fatty Acids obtained.
Per cent.	Per cent.	
I. .. 82·70	17·30	14·70
II. .. 81·10	18·88	18·55 dif. 0·33
III. .. 69·79	31·21 beef fat	31·42

The sinking-point of this last mixture was 39·5° C., 4° above that of genuine butter: these 4° are due to 35·05 per cent of foreign fat: 100 per cent of it would, therefore, raise the sinking-point 11·4°, making it 46·9°. Fat having a high fusing-point (in this case ox-fat) has therefore been used as an adulterant.

The process of saponification as first carried out by us is as follows:—From 3 to 4 grms. of perfectly dry butter-fat are weighed out from a test-tube into a large, deep, porcelain dish; about three-fourths of a stick of caustic potash in solution is added; the mixture is kept boiling, with frequent stirring and addition of evaporated water, until a perfectly clear soap is obtained: this usually takes from 3 to 6 hours. The soap, whilst warm, is decomposed with weak hydrochloric acid, and the heat kept up until the released fatty acids form a clear oily stratum on the hot solution of potash salts, glycerin, and soluble acids.

The fixed acids are caught upon a wet filter (which it is as well, but not absolutely necessary to keep warm with a steam or hot water jacket), and well washed with boiling water until the filtrate is quite free from acid reaction, or any odour of volatile acids. It is necessary to use a large amount, half a litre of wash water, in order to get rid of every trace of the acids, some of which, especially caprylic acid, are very sparingly soluble in water; when well washed the fixed acids soon become constant in weight.

Mr. George Turner, of Portsmouth, has recently discovered that by making use of alcohol in the process of saponification, much time may be saved, and that without in the least degree interfering with the accuracy of the method; in which the fat seems to be

* Read at the meeting of the Society on June 2.

presented to the action of the alkali in a finely divided condition, and therefore chemical changes are speedily brought about. A clear and perfect soap may be got in from fifteen to thirty minutes.

The process is as follows:—3 to 4 grms. of fat are weighed into a porcelain dish, capacity about 100 or 150 c.c., melted over water-bath and treated with from 20 to 30 c.c. alcohol, or methylated spirits; three-quarters of a stick of potash is added, and then water a few drops at a time, so as to gradually dissolve the potash; by adding the water carefully at intervals until this point is reached, no turbidity, or only a transient one, is produced, and afterwards it may be used freely. The soap must now be quite freed from alcohol by boiling; when this point is reached it remains perfectly clear, has no spirituous smell, and usually a soapy pellicle forms on the surface.

The advantages of saponifying with the aid of alcohol over our original method, with water and KHO only, are that violent boiling is dispensed with, and that the dish is smaller, and exposed for a shorter period to the solvent action of the alkali, besides which much time is saved.

It is a matter of the utmost importance that the fat should be perfectly dry, and free from every trace of casein and salt. I have found that after prolonged heating in the water-bath, filtration is a tolerably quick and sure method of obtaining this condition.

Great care must be observed in the washing, never to allow any part of the filter to become dry, or fat will surely pass through.

NOTICES OF BOOKS.

A Digest of the Reported Cases Relating to the Law and Practice of Letters Patent for Inventions. By Clement Higgins, M.A. F.C.S., of the Inner Temple, Barrister-at-Law. London: Butterworths.

That modest and virtuous party who agitate for the abolition of patent-right argue that their scheme, even if fully successful, would not check the career of industrial improvement. "The inventor," say they, "is like a hen which cannot help laying." Whilst duly appreciating the bare-faced cynicism of this comparison, we will, for argument sake, take them at their word.

A hen may not be able to help laying, but if not made comfortable at home she may "lay away." Just so the inventor; if he finds himself systematically pillaged in his native country may carry his ideas to where they will be better appreciated. Already industrial and scientific papers in America are speculating on the consequences of the Lord Chancellor's meditated inroads on the old patent laws of England. They are very plainly reminding the British inventor that if deprived of his indisputable rights at home he will be received with open arms in the United States, where for the small sum of 35 dollars he can secure an invention, not for seven or fourteen, but for seventeen years, without being called upon for any further payment, where though a thousand patents are granted monthly, the average value of a patent is greater than in Europe, and where from the more enterprising character of manufacturers and capitalists an improvement can more readily meet with a fair trial. Hence we believe that the Lord Chancellor's bill, outrageous as are certain of its provisions, will, if carried, prove far more injurious to British manufacturing supremacy than to the general progress of industrial science, or than to inventors as individuals.

It is perfectly natural that at such a juncture, when our old patent system, without which, as an eminent German contemporary observes, the colossal industry of Britain would be "simply inconceivable" an increased attention should be paid to the laws bearing upon the subject of protection to inventions, and to the decisions by which the Courts are in a great measure guided. The appearance of Mr. Higgins's "Digest" is therefore exceedingly opportune. The plan of the work is definite and simple. The author, as he remarks in his preface, has sought to furnish "a reliable and exhaustive summary of the reported patent law cases decided in English Courts of Law and Equity. No opinion is expressed upon the cases given, and no attempt is made to reconcile conflicting decisions. All that the book contains rests upon the authority of the judges." The decisions are arranged under such heads as subject-matter of letters patent, novelty of invention, utility of invention, who may be a patentee, application for letters patent, grant, title of patent, provisional and complete specification, &c. The cases under each of these sections are classified in order of time.

Among the most interesting points handled in the work is the question as to whether a principle can be made the subject of a patent. On this head the decisions quoted are unanimously negative. You may patent any novel method of carrying a given principle into beneficial effect, but the principle itself remains public property. Thus, taking the well-known instance of a red colouring matter derived from the action of oxidising agents upon mixtures of aniline and toluidin. So soon as one oxidising agent had been claimed for effecting this purpose there was a perfect rush of applications, until every known oxidising agent, suitable or unsuitable, had been patented for the purpose in question. Now the bulk of these patents were neither useful nor meritorious. If it is once known that a certain effect can be produced by an oxidiser, there is very little merit in turning over the leaves of some manual of chemistry, selecting some other oxidising agent there mentioned, and patenting it for the object in question. Therefore it has been contended, we should allow a right in principles and enable the first discoverer of magenta to claim the action of oxidising agents upon mixtures of aniline and toluidin. To this the reply is obvious. Some oxidising agent might be hereafter discovered, better adapted for the manufacture of magenta than any then known. Would it then be fair to give the original patentee an exclusive right to something not in existence at the time of his patent and only elicited since by the labour and sagacity of some other person?

We may on future occasions return to this subject, and to other of the many interesting questions which the decisions before us naturally suggest. We consider that Mr. Higgins, in the production of this work has met a long-felt demand. Not merely the legal profession and patent-agents, but patentees, actual or intending, inventors, manufacturers and their scientific advisers will find the "Digest" an invaluable book of reference.

CORRESPONDENCE.

ESTIMATION OF PHOSPHORIC ACID AS AMMONIO-MAGNESIAN PHOSPHATE.

To the Editor of the Chemical News.

Sir,—Mr. Warington was kind enough a few days ago to write to me regarding my paper on the above subject (vol. xxxi., p. 274) in the following terms:—"You do not seem to mention one condition of the experiment—the *excess of ammonia* present. Was this condition uniform throughout? Of course the greater the excess of ammonia the more probability there is of impurities accompanying the precipitate. If you used citric acid in a free state, how did you preserve the uniform excess of ammonia?"

My reply was as follows:—"I beg to thank you for your courtesy in writing to me personally regarding the detail of my paper referred to by you. The quantity of free ammonia was the same throughout all the experiments, and I endeavoured to arrive at this result by first of all cautiously saturating the citric acid, and then adding a

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definite quantity of weak ammonia, viz., 5 c.c. Owing to accidental circumstances my paper was drawn up in its present form at a time when I could not continue the experiments further and ascertain the influence of *varying quantities* of free ammonia, and also examine into other points. However, I am not prepared to admit that the amount of ammonia used by me can be held as accounting for any of the results given. I have wrought with the magnesia method for a number of years —formerly almost daily—and have not only avoided a *large excess* of ammonia, but also have taken care to add this excess in the form of a *dilute* solution."

As no mention was made in my paper of the quantity of free ammonia used in the various experiments detailed in it, I ask you to do me the favour of inserting this note.—I am, &c.,

THOMAS ROBERTSON OGILVIE.

Greenock, August 3, 1875.

DETECTION OF COBALT AND NICKEL.

To the Editor of the Chemical News.

SIR,—I read with some surprise in (CHEMICAL NEWS, vol. xxxii., p. 44) a paper from Mr. R. H. Davies on "The Detection of Cobalt and Nickel by means of Ferro- and Ferri-cyanide of Potassium," to which method he appears to lay claim. Allow me, as one of the students at the Pharmaceutical Society last session, to state that this method for the detection of cobalt and nickel was found out by Messrs. Compton and Gostling, two students at Bloomsbury Square last session.

A. P. LUFF.

Prospect House,
South Kensington, S.W.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—Allow me a few observations on this new idea.

Mineralogy is a distinctive branch of Natural Science.
It is a Science of Great National importance.
The Nation possesses a matchless Collection of Minerals.
It has also, within it, some excellent Mineralogists.
It never had a distinctive Society of Mineralogists.
Chemists and Geologists *condescend* only to Mineralogy.
(The Society of Chemists having "many other fish to fry;
The Society of Geologists being absorbed in Palæontology).
The Nation has no Standard Book of Mineralogy.
The Books in general use are widely discrepant,
And treat of many Minerals of doubtful existence.
There is no uniformity of Mineral Nomenclature.
This state of things is altogether inappropriate,
Is very perplexing to our Mineralogical Students,
An avoidable hindrance to the Advance of Science,
Which a *Mineralogical Society* of London might reform.

T. A. READWIN.

Liverpool, August 7, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, tome lxxxi., No. 2, July 12, 1875.

Magneto-Chemical Phenomena Produced in a Medium of Rarefied Gases in Geissler's Tubes Illuminated by means of Induction Currents.—M. J. Chautard.—(Third part.) In all the simple bodies of the chlorine group, and in all their derivative compounds, gaseous or volatile, which have been examined, the action of the magnet is instantaneous, and is shown—not merely by a change in the tint of the tube—but, above all, by a more complete illumination of the rays which display a wonderful brilliancy, and are sometimes split up. The wave-lengths of each ray will form the subject of a future communication. The substances examined, beside chlorine, bromine, and iodine, are the chloride, bromide, and fluoride of silicium, the fluoride of boron, hydrochloric acid, antimony chloride, bismuth chloride, mercurous chloride, and stannous and stannic chlorides. The lights of sulphur and of selenium are completely extinguished in the moment when the magnet is set in action, and it is the same with that of tubes of chlorine, bromine, and iodine if the strength of the coil is suitable. The lustre of the light of oxygen, always pale, undergoes no very sensible change. It is the same with the compounds of carbon, such as carbonic acid and oxide, proto- and bi-carbide of hydrogen. The fine bands of the nitrogen spectrum are merely modified in the red and orange portion. These colours are almost entirely extinguished, or, at least, are replaced by a very uniform tint, in which there is no trace of "chanelling." The bands of the more refrangible portion remain unaltered. The rays of hydrogen preserve the same appearance; yet, on employing an electro-magnet of sufficient strength, we see appear at the moment when it is set in action a very brilliant yellow ray, which is merely that of sodium derived from the glass. This ray vanishes as soon as the circuit is broken, and reappears if the magnetisation is resumed. Proto-chloride of tin, dry and crystalline, but bihydrated, presents a most remarkable phenomenon of dissociation under the influence of the magnet. In its normal state the spectrum is pale, and presents some of the green rays of chlorine; but as the magnet is set in action we see two of the characteristic rays of hydrogen, the red and the blue, which remain as long as the magnetisation lasts, and disappears when it ceases.

Fused Boracic Acid, and on its Temper.—V. de Luynes.—Fused boracic acid, which approaches glass in some of its external characteristics, presents some properties worthy of note. In the viscid state it may be drawn out into threads, which solidify rapidly, and from this point of view its ductility rather resembles that of silica than of glass. Its hardness, between 4 and 5, places it between fluor-spar and apatite; it scratches glass, and is with difficulty attacked by sand, and even by emery, dry or with oil. It takes seven to eight times as much time in grinding as glass under the same circumstances. This resistance to friction, which does not accord with its hardness, depends doubtless, as M. Damour has recognised in the case of other minerals, on a speciality of structure. Melted boracic acid, in mass, becomes slowly hydrated in contact with water. In powder it is acted on rapidly, as shown by Ebelmen. If the powder is sprinkled with water, its temperature may rise to 100°. Boracic acid is chiefly remarkable for the persistence of its temper. If poured upon a cold metallic surface glassy plates are obtained, the under surface of which, chilled by the metal, is more strongly tempered and more expanded than the upper. Hence results a flection which may be strong enough to cause the rupture of the plate and its projection in fragments. If poured into oil it may be obtained in small masses with short tails, under the same conditions as Prince Rupert's drops. A tempered plate of boracic acid, with parallel surfaces, acts upon polarised light like tempered glass; but whilst the latter loses this property by re-heating, boracic acid preserves it with great tenacity.

Laws of Exchange of Ammonia between the Seas, the Atmosphere, and the Continents.—M. Th. Schlœsing.—The author considers that he has discovered, if not the mathematical expression of the laws sought for, yet at any rate numerical data. These he intends shortly to communicate.

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Description and Analysis of a Mass of Meteoric Iron Fallen in Dickson County, Tenessee.—Lawrence Smith.—The composition of this meteorite is—

Iron	91·15
Nickel	8·01
Cobalt	0·72
Copper	0·06
	99·94

There is no trace of sulphur, and unusually slight indications of phosphorus.

Temporary Magnetisation of Steel.—M. Bouty.—A mathematical paper, not adapted for abstraction.

Determination of Sulphide of Carbon in the Alkaline Sulpho-Carbonates of Commerce.—MM. Delachanal and Mermet.—This paper requires the accompanying diagram.

Preparation of Tungsten, and the Composition of Wolfram.—M. F. Jean.—The author heats to low redness for half an hour in a crucible or in a reverberatory furnace wolfram reduced to an impalpable powder, and intimately mixed with 3 per cent carbonate of lime, and 20 to 30 per cent chloride of sodium. When the mixture is cold it is powdered, and boiled for a quarter of an hour with hydrochloric acid, which dissolves lime, ferric and manganic oxides, and leaves undissolved all the tungstic acid in the state of a crystalline powder of a fine lemon-yellow colour, which is purified by repeated washings in acid, and is then converted into tungsten by reduction with hydrogen at a red heat. The author concludes that wolfram is a tungstate of the protoxides of iron and manganese.

Certain New Derivatives of Anethol.—M. Fr. Landolph.—The author examines the hydride of anethol, or anisic camphor, $C_{10}H_{16}O$.

Researches on Emetine.—M. A. Glénard.—The author finds emetine to contain—

Carbon	72·25
Hydrogen	8·61
Nitrogen	5·36
Oxygen	13·78

represented by the formula $C_{30}H_{22}NO_4$.

Central-Blatt fur Agrikultur Chemie,
Heft 5, May, 1875.

Influence of Atmospheric Pressure and Rainfall upon the Subsoil Water.—Dr. A. F. Nowack.—The water level does not rise after rainfall, but before it, and announces rain thus with more certainty than the barometer.

Beet-Root Treacle as a Manure.—A. Gawalowski.—300,000 cwt. of beet-root yielded 7500 cwt. treacle, containing 495 cwt. potash, 37·5 cwt. lime, 4·5 cwt. phosphoric acid, 15 cwt. sulphuric acid.

Wool-Waste as a Manure.—Dr. A. Petermann.—Various samples contained from 2·14 to 6·67 per cent of nitrogen.

Experiments on the Yield of Plots of Land Treated with Artificial Manures as Compared with Unmanured Plots.—Bruhn.—The manures used were superphosphate made from "Baker guano," containing 20 per cent of phosphoric acid, and blood manure containing 5 per cent nitrogen, and 6 per cent of phosphoric acid. The plots of land were very small, and the superphosphate furnished no manurial element except phosphoric acid.

A Manurial Experiment on Sugar Beets.—E. Breymann.—The author concludes that with care good beets can be obtained even from strongly manured land.

Composition of Bones during Variations in Food.—Dr. H. Weiske.—Animals were fed on substances deficient in phosphate of lime. The total amount of osseous matter formed in their bodies was reduced, but the chemical composition of the bones remained unchanged. The amount of magnesia in the bones was not augmented in animals to whom magnesium phosphate was purposely given. Strontia given in food only appeared in traces.

On Chitin.—O. Bütschli.—The nitrogen, by the method of Dumas, was determined at 7·4 per cent. By the process of Varrentrapp and Will it appeared 1 per cent lower. The author considers chitin as a derivative of a hydrate of carbon—probably of a body resembling cellulose.

Digestion of Albumen.—B. Maly.—The author concludes that pepton is an organisable product of digestion, capable of decomposing albumen, and of re-conversion into albumen.

Removal of Alkalies from the Animal System.—J. Kurtz.—A dog was first dosed for some time with sulphuric acid to minimise the disposable alkali in its system, and then fed with meat freed from alkaline salts, to which 2 per cent of neutral phosphate of potash was added. The excretion of soda decreased continuously.

Milk of Different Breeds of Cows on Different Diets.—A translation of a recent paper by Stevenson Macadam.

Structure of Seed Capsules.—Dr. Anton Sempolowski

Occurrence and Origin of Woody Fibre in the Tissues of Plants.—A. Bürgerstein.—A physiological paper.

On Chlorophyll.—J. Chautard, E. Prillieux, E. Filhol, and A. Batalin.—Extracts from *Comptes Rendus.*

Gas of Apples.—C. Bender.—From the *Berichte der Deutschen Chemischen Gesellschaft*, No. ii., p. 112.

Certain Chemical Changes During the Germination of the Pea.—O. Kellner.—Not adapted for abstraction.

Influence of Locality on the Composition of the Ash of the Larch.—Rudolf Weber.—The organic matter increases in a regular proportion with the height of the locality. The ashes follow the inverse proportion. The larch demands double the amount of potash and phosphoric acid which suffices for the Scotch fir, and the beech three times as much as the larch.

Composition of Must at Different Periods of the Ripeness of the Grapes.—A. Cossa, Dr. Pecile, and Dr. Porro.—The amount of sugar and extractive matter increases continuously to September 20th, after which these constituents decline.

Contributions to the Chemical Knowledge of Vegetables and Pot-Herbs.—W. H. Dahlen.—Comparative analyses of a number of vegetables in domestic use.

Distribution of Sugar and Mineral Matters in the Sugar-Beet.—Ch. Violette.—From *Comptes Rendus*, lxxix., p. 899.

Nutrition of the Sugar-Beet by Loosening the Soils.—P. Bretschneider.

Experiments on the Yield of Potatoes.

Experiments on the Yield of Hemp.—Brugger.—The crop was augmented by manuring with common salt and by loosening the subsoil.

Acid Boiling on Margueritte's Principle.—Kolb Bernard.—Experiments on "acid boiling" of the syrup drained off from the first yield in the sugar manufacture.

Composition of Washed Wool.—Prof. Max Märcker.—There exist in Germany establishments where wool growers send their wools to be washed. There is considerable doubt as to whether the wool is returned correct in quantity and uninjured in quality.

Blasting Roots with Dynamite.

Part Played by Bacteria in Putrefaction, especially i Case of Urine.—Dr. A. Hiller.

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Alcoholic Formation of Milk-Sugar and Milk.—*Prof. E. Reichardt.*

Gazzetta Chimica Italiana, Anno v., 1875, Fasc. v.

Products of the Action of Urea upon Asparagin and Aspartic Acid.—Icilio Guareschi.—The author's researches are incomplete, and have not led to any definite result. Among the products some appear different from those obtained by Grimaux (*Comptes Rendus*, lxxx., p. 828). He proposes to resume the subject.

Preliminary Note on Parabanic and Oxaluric Acids. Icilio Guareschi.—The author, having caused oxamide to react upon urea in order to effect the synthesis of parabanic acid, seems to have obtained oxaluric acid, probably derived from the hydration of the parabanic acid formed at first.

Vegetation of Oxalis acetosella, Rumex acetosa, and R. acetosella in a Soil Devoid of Potash.—M. Mercadante.—The plants were grown in a soil composed of 1 kilo. of sulphur mixed with the following salts:—

Nitrate of lime..	2·000 grms.
Nitrate of soda..	0·792 „
Phosphate of lime	2·610 „
Phosphate of soda	0·100 „
Phosphate of magnesia ..	3·800 „
Oxide of iron	0·100 „
Sulphate of iron	0·200 „
Silicate of soda..	1·000 „

As a substitute for organic matter were added 20 grms. of glucose. The experiments proved that potash is not indispensable for the formation of oxalic acid, it being in part replaced by lime: but the vegetation in this case is meagre, and the plant does not form seeds.

Abstract of Certain Memoirs on the Detection of Poisonous Alkaloids, Read before the Academy of Sciences at Berlin.—Prof. F. Selmi.—Incapable of useful abridgment.

M. Reimann's Farber Zeitung, No 25, 1875.

This issue contains a notice of the "hydrosulphite" vat which has been found to effect a great economy in indigo, but the use of which, in Belgium and France, is said to be checked by the high royalty demanded by the patentees. The editor is highly indignant with these gentlemen, because they are unwilling to give dyers in Germany, where the process is not protected, instructions in its use!

The ukase forbidding the importation of artificial alizarin into the Russian Empire is supposed to have for its motive the protection of the madder cultivation in the province of Daghestan.

There are, further, receipts for a fast black on wool, a green, magenta, and pansy on mixed silks.

Turkey Reds with Artificial Alizarin.—Dr. P. Römer. Cotton yarn to be dyed with artificial alizarin is oiled in the ordinary manner used in case of madder or garancin. Perhaps one oil-bath may be dispensed with. The remainder of the process is carried on in a different manner. The treatment with tannin is suppressed, and the oiled yarns are passed at once into the alum mordant, which should be as neutral as possible. To 50 kilos. of crystalline alum take 15 kilos. of soda crystals; mix the aqueous solution, stirring well, and set the clear liquid at 5° B. The cotton steeps for a day in this liquid, and is then very carefully washed and wrung out. The dye-beck consists of alizarin and tannin, ¼ kilo. of the latter per 50 kilos. of yarn. If the water is not calcareous, 100 grms. of chalk must be added for the above quantity of cotton. The dyeing is carried on very slowly and gradually, beginning with a perfectly cold beck, which is raised to a boil in two hours, and kept at that point for another hour. The yarn is then not cleared, but raised at once with curd soap and annatto. Treatment with tin crystals is only required for rose shades.

No. 26, 1875.

In this issue a garment dyer, expected to renovate worn-out rags, gives poetical expression to his wrongs.

There are receipts for printing a fire-red on woollen yarns and pieces; for an amaranth on the same material; a safflower-rose on cotton, a wood-blue, and an olive on woollen yarns; and a chamois on tanner's wool.

Apparatine, a new material for finishing cottons, is prepared from a mixture of 76 parts water, 16 parts potato-starch, and 8 parts soda-lye at 8° B. The starch is put into the water with constant stirring, and the lye is added. The jelly, which is quickly formed, is beaten. The finished product is a colourless, inodorous mass, of glue-like nature, and dries on exposure to the air. It is said to serve as a thickener in printing.

Les Mondes, Revue Hebdomadaire des Sciences, No. 12, July 22, 1875.

This issue contains no original chemical matter which has not been already noticed.

MISCELLANEOUS.

British Association for the Advancement of Science.—The arrangements for the forty-fifth meeting of the British Association, to be held at Bristol on the 25th inst., are approaching completion. The President and Lady Hawkshaw will be the guests of the Mayor, who will inhabit the new Mansion House recently presented to the city by Alderman Proctor. The Secretaries of the various Sections will be lodged at the Queen's Hotel. The following are the officers: — *President-Elect* — Sir John Hawkshaw, F.R.S.. *Vice-Presidents-Elect*—The Rt. Hon. the Earl of Ducie, F.R.S.; the Rt. Hon. Sir Stafford Northcote, Bart., F.R.S.; the Mayor of Bristol; Major-General Sir Henry C. Rawlinson, F.R.S.; Dr. W. B. Carpenter, F.R.S.; W. Sanders, F.R.S. *General Secretaries*—Capt. Douglas Galton, F.R.S.; Dr. Michael Foster, F.R.S. *Assistant General Secretary* — George Griffith, F.C.S. *General Treasurer*—Prof. A. W. Williamson, F.R.S. *Local Secretaries*—W. Lant Carpenter, F.C.S.; John H. Clarke. *Local Treasurer*—Proctor Baker. The following are the Presidents and Secretaries of the Sections:—A. Mathematical and Physical Science. *President*—Prof. Balfour Stewart, F.R.S. *Secretaries*—J. W. Glaisher, C. T. Hudson, J. Perry, G. F. Rodwell. B. Chemical Science. *President*—Prof. A. G. Vernon Harcourt, F.R.S. *Secretaries*—Dr. H. E. Armstrong, W. Chandler Roberts, W. A. Tilden. C. Geology. *President*—Dr. T. Wright, F.R.S.E., F.G.S. *Secretaries*—L. C. Miall, E. B. Tawney, G. Topley. D. Biology. *President*—P. L. Sclater, F.R.S. *Secretaries*—E. R. Alston, Prof. W. R. M'Nab, F. W. Rudler, Dr. P. H. Pye Smith, Dr. W. Spencer. E. Geography. *President* — Major-General Strachey, F.R.S. *Secretaries*—H. W. Bates, E. C. Rye, F. F. Tuckett. F. Economic Science and Statistics. *President*—James Heywood, F.R.S. *Secretaries*—F. P. Fellowes, T. G. P. Hallett, E. Macrory. G. Mechanical Science. *President* —William Froude, F.R.S. *Secretaries*—W. R. Browne, H. M. Brunel, J. G. Gamble, J. N. Shoolbred. The President's Address will be delivered on Wednesday, August 25, at 8 p.m. On Thursday evening there will be a *Soirée*. On Friday evening, at ½-past 8, Mr. Spottiswoode will discourse on "The Colours of Polarised Light." On Saturday evening Dr. Carpenter will lecture to working men on "A Piece of Limestone." On Monday evening, the 30th inst., Mr. Bramwell will lecture on "Railway Safety Appliances." On Tuesday evening a second *Soirée* will be held, and on Wednesday, September 1st, the concluding General Meeting will be held.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 821.

THE COPPER-ZINC COUPLE AND ITS EFFECTS.*

By J. H. GLADSTONE, Ph.D., F.R.S.,
Fullerian Professor of Chemistry in the Royal Institution.

I PROPOSE, ladies and gentlemen, to bring before you in this lecture a series of researches which have been made during the past two or three years by Mr. Tribe and myself. They have been made partly in my own private laboratory and partly in the laboratory of this Institution. They are the work of what we call the copper-zinc couple, and my first duty, I think, will be to explain the principle of that couple.

We have here a simple galvanic cell: that is to say, we have two different metals, in this case copper and zinc, because I mean to keep to zinc and copper pretty much during this afternoon. At present the metals are not connected with one another except by that liquid. The liquid is dilute sulphuric acid. There is a magnet just taking up the ordinary position of the meridian. We have arranged it so that the magnet points towards the two metals, because that is the direction of north and south. Supposing I connect those metals by any metallic junction, such, for instance, as this other piece of zinc, we shall see that something takes place. That magnet, you see, is at once started, and swings round to one side considerably, and will remain permanently on one side, while, at the same time, you will observe there are bubbles of gas forming on the copper plate, and rising up to the surface of the liquid. I think that the contact has been broken for a moment. Now I will make it again, and you perceive that again this magnet swings, and the bubbles of gas rise upon this copper plate.

Now, how are we to conceive of this? There is no action taking place between this copper plate and the liquid in the way of solution. It is the zinc which is dissolving off; but, at the same time, this hydrogen which is being produced by the action of the zinc is actually given off at about 10 in. distance on the copper plate. That there is something going on is evidenced by the moving of the magnet. It is true that this magnet is affected by two things here, the liquid and the connecting metal. It may be affected by either, and at present it is being affected by both. Now, how are we to conceive of what is taking place under these circumstances in the liquid.

Well, we must have some kind of theory—some kind of view. It is very difficult for us to imagine exactly what is taking place; but still I endeavoured to illustrate it in the juvenile lectures by means of a moving diagram. Here is a diagram representing two plates, one of copper, and the other of zinc: these are supposed to be in metallic connection one with the other, and the liquid between them is subjected to some kind of strain, or tension, and therefore some kind of change takes place in it. Now, we believe that in the first instance the molecules—or little parts of which it is composed—arrange themselves in some particular order; that, in fact, the oxygen turns itself towards the zinc, and the hydrogen turns itself in the direction of the copper. What takes place? The oxygen, or the sulphuric acid—for it is sulphuric acid in the cell of which I have been speaking—combines with the zinc, and the zinc dissolves away and comes out into the liquid, and, at the same time, the hydrogen is deposited upon the copper. You may suppose that these spots represent the hydrogen. The hydrogen is being deposited on the copper, and goes away. Then more hydrogen comes in occupying its place, because it is always passing on. This hydrogen passes away also; more hydrogen comes, and in the meantime the zinc is dissolved and is going into the liquid. The sulphuric element remains in about the same place, but there is constantly a passage of the hydrogen which is being thrown off. [The molecular changes were represented by means of the working diagram.]

We may go on in this way till all the hydrogen is expelled, and we have the whole liquid filled simply with a compound of zinc. Well, that is one conception that we may form of it. Suppose, instead of this, we take another—a somewhat crude contrivance. Here I have arranged a number of balls, which may represent the sulphuric acid and the hydrogen. These are the sulphuric element, and those are the hydrogen, and I have placed them alternately. Now we will suppose that a force is exerted here,—this galvanic force, or electro-motive force, or chemical force, whatever you please to term it. We will represent this force by the falling of a little ball. Then what happens? The force goes through the whole, and there is very little change at the first ball, but a considerable amount of change at the other end. The last ball flies out. I cannot go on with the experiment now, because I shall have to change the order of these balls. Well, I make that change, and then there is a fresh impulse given, and more hydrogen is sent off. [Illustrating.] This is a rough and very crude idea of what may be taking place in that liquid.

The whole amount of force that is capable of being generated by that zinc plate, and that copper plate, is not employed in the decomposition of that liquid, and I will point out to you where there are two sources of loss of force. If I make these metals touch together, at once we shall see that an action takes place, and our magnet swings. But these junctions are very imperfect indeed, and there is a certain loss of force in them. If, instead of taking a piece of metal like this I had taken a very long wire, as in our electric telegraphs, the loss would have been much greater. But that loss of force is notning compared with another. It is what is called the external resistance. Sometimes it is very great, but in this case it is not great. But there is a loss of force in the liquid itself, by its resistance. The liquid does not yield readily to the strain. There is something—some power in the liquid itself which holds its particles together, and it will not be influenced at once or readily by the galvanic current that passes through. Now, this resistance varies with different liquids. With all it is considerable. Even with the dilute sulphuric acid which we have here it is very great indeed compared with what it would be if a metal were between the two plates. But suppose that, instead of taking sulphuric acid, I had taken pure water; it would have been very much greater. Supposing I had taken some organic liquid, such as alcohol, it would have been greater than in the case of water. Let me illustrate it in this way—very roughly indeed. Suppose that we are operating with this illustrative apparatus, and we take our force; what do we have? A certain effect produced at the other end. Away goes our ball to that distance. We will mark that distance. Well, now we will take balls of another substance. These are balls of another kind, which we may suppose to represent atoms of another nature; but we will employ the same force. These are wooden balls, and the others were some kind of porcelain or stoneware. We will employ the same force by means of this falling ball, which represents the electromotive force; but now we have got a different material to deal with—a different material through which to send our shock; what will be the effect? Now, you see, the ball does not go to the same distance. You can easily understand that it depends upon the nature of these particular balls how far the force will be transmitted. It depends upon whether they are more or less elastic, and hence I

* Verbatim report of a Lecture delivered at the Royal Institution, London.

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use this as an illustration of the amount of resistance that is offered by different liquids.

This resistance differs according to other circumstances. I think that we might show you that also. You will probably remember that when I took all these balls, and caused the force to be exerted through all of them, the ball at the end did not travel very far. I will repeat the experiment. I will cause the force to be exerted, and you will see the distance to which it sends the ball from the end. Supposing I take a much shorter distance, a smaller amount of material; we shall find that the same force will send the ball very much farther.

Well, now, I want to show you that with regard to water. I have here a little pure water in this vessel, and we want to arrange it so as to see whether distance—whether the length of the water—has not a great deal to do with this phenomenon. I take here the same metals which I have employed before—zinc and copper. I have wires joining them, and passing through this apparatus—this Thomson's galvanometer—which I need not explain to you now. What I want to draw your attention to is this—that a feeble current passes through that apparatus, and we are able to show the movement of a small magnet—a very minute, delicately suspended magnet—which is there, and which has a mirror upon it. The light from this lamp will be reflected from the mirror, and will be thrown upon the screen. We must allow the beam of light to come to rest. You see there it is, just at the edge of the screen, swinging backwards and forwards. Now I place these metals in the water: you perceive that it brings the beam of light to a certain distance. There is a certain amount of force going through the instrument, and it moves the beam of light away, bringing it fairly on to the screen. Now at present I have about 2 in. of distance of water. I will take about half that: you perceive that then the image of the mirror is brought farther on the screen. There is more action, more movement of the magnet. Supposing I bring it a little nearer still. Then you perceive that they come nearer and nearer to one another. As I advance, and bring them close to one another, you perceive that the image advances farther and farther. I will endeavour to bring them nicely close by the side of one another. There you see, the beam has advanced considerably from the edge. It is swinging backwards and forwards, it is true, but still it has considerably advanced. Now I will move the metals nearer, and you see that the beam has moved to a more advanced part of the screen. I do not think that I need push it further in order to show that the amount of distance in the water has a great deal to do with the amount of movement, and that the water offers a large amount of resistance. If I take only half the amount of water a larger amount of the current passes through, and thus the image travels farther along the screen. If I bring the two plates very close to one another, as I did in the last instance, we bring the image far on to the screen. I will do it again. There it goes with a good swing. This shows that we have a considerable amount of force.

Now, I want you to bear in mind very distinctly that this resistance varies very much with the length of the liquid that is between the two metals.

The virtue of our copper-zinc couple is that, by means of it we are able to get rid entirely of external resistance, and reduce the internal resistance of the liquid to the very minimum. We take zinc and we deposit copper upon it in a myriad of different places, and we immerse the whole in water, or any other liquid that we want to act upon. Then, of course, there is no external agent at all, because the whole thing is inside the water, or the liquid that is to be acted upon; and as to the distance of the water, the water will wet the whole thing. It will go all round the zinc and the copper and be acted upon. But I must show you that by means of the microscope. We will take some zinc, and show you how it decomposes the copper solution. It takes the place of the copper, and the copper is thrown down upon it. [A magnified shadow of the vessel and preparation was thrown upon the screen.] There is the zinc, and there is the copper. The copper will pass out of solution and be deposited on the other pieces of copper already thrown down, and the zinc will dissolve.

We have already made some preparations. The copper is deposited slowly: and I think it would tire your patience if you were called upon to wait for it. Here is some that has been prepared a little while before the lecture, and it has grown. This black image is the piece of zinc, and here is the copper which is growing. Of course, you see only the shadow of the copper and the zinc in this instance, and hence the things appear black. This is not really black: it is red copper; but the shadow, of course, is black. You see these crystals that have grown out in various ways. Here is a piece of crystalline copper. See the graceful forms into which it has grown! Here are great masses of copper which have formed at the end of the crystals, and which have stopped the progress, as they generally do. There is the deep-coloured chloride of copper, and here are the crystals growing into it, and there are bubbles which are being formed. These two substantial crystals of copper are very like, in shape, the native metal that we get from Canada and elsewhere. I am sorry that I cannot show you the copper growing, but only some of the copper which has been formed. We will take another metal. Instead of zinc and copper we will take zinc and tin. The tin is deposited much more rapidly than copper is, and hence we can see it being deposited before our eyes, and growing. The zinc in the copper solution is now fringed with crystals, and there are bubbles and currents in the liquid, and these crystals of copper are certainly much larger and longer than when it was first placed upon the screen; but still, I will try to show the action with tin much more rapidly. You see the crystals shooting forth—very beautiful points darting forward in the liquid. These are crystals of tin which are being formed upon the zinc, just in the same way as the copper, of which I was speaking just now. You perceive they are gradually growing and pushing their way into the liquid. Let us try some other parts of the liquid—try the other side, and see how they are growing there. Look at this thread. It is growing gradually, and becoming thicker and thicker, with fresh crystals deposited upon it. I will call your attention to the formation of bubbles here. This made a start, just now, and pushed aside some of the crystals which were growing upon it. This is the thin thread of tin to which I alluded just now, and you see how it has grown and shot out this large vegetation of tin at the side of it. You perceive, therefore, this beautiful natural growth of the metal round about the zinc while the zinc is displacing the metals from their solution.

This so far, then, will illustrate to you that zinc is capable of turning out other metals from their solution, or, as we say, it has a greater affinity for the acid than these metals, for it dissolves away in the acid, and these metals remain. Now, suppose I were to take some sheet zinc, which I have here. I will take a piece of it and straighten it out. Now we will put that into a solution of sulphate of copper. I do not know whether we shall see it best by lamp-light or by daylight. Perhaps the daylight will show it best. As I put this into the blue sulphate of copper, you see at once that this bright zinc is losing its lustre. It is becoming grey; and as it goes down further you perceive that this portion which has been longest immersed becomes very black, and bubbles arise at the same time. The zinc is becoming covered with a black deposit of copper. Now we will allow that to go on before your eyes, and you perceive that it passes through a greyish colour into this black colour. This deposit is metallic copper, though perhaps you are not accustomed to think of metallic copper as black. We generally think of it as red; but its colour depends upon its state of division and upon other circumstances. I do not know why it is, but

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I think I may fairly say that every metal, if formed sufficiently slowly and in sufficiently fine crystals, appears perfectly black; and this copper upon the zinc, as we make it for our zinc couple, appears of a velvety black, or nearly as black as velvet, which is the blackest of all blacks. It is what we saw magnified on the screen just now; that is to say, there are myriads of crystals of copper—similar crystals to those which I magnified. I purposely made the largest crystals I could; but there are myriads of crystals of copper all over the surface of this zinc, touching it at a great number of points; so that if we put it into water, or into any other liquid, the liquid will wet it all over, and get all among the crystals of copper to the zinc. We will allow this to remain until the end of the lecture, and I should not wonder if by that time the zinc removes all the blue colour from the liquid.

The way in which we make this couple, then, is to take a quantity of this zinc-foil and to pour upon it some sulphate of copper. The copper deposited has to be washed and dried. Generally speaking, we wash it by means of water, then by a little alcohol, and afterwards by ether. We dry it in the way which Mr. Williams will kindly show to us now. You are aware that ether is a very volatile substance, and it cannot be heated without very soon going away altogether, and therefore we warm it in an atmosphere of carbonic acid gas. When we begin to warm it, we first of all see that the ether is really going off, and then we light it in this way. [The jet of ether vapour which issued from the vessel in which the couple was being dried was ignited.] We can see when there is no more ether left by its ceasing to burn. Now during this time we are, of course, removing any extraneous substance. You recollect that the sulphate of zinc has already been washed away from the couple, and this ether is just to remove the last trace of water or of alcohol that may be employed.

We have now driven off nearly all the ether. Here is carbonic acid being produced, and it is bubbling through sulphuric acid in order to be dried, because we must use dry gas. The dry carbonic acid is taking the place of the ether. If we go on heating the flask more we shall find that a change takes place. Although there is not a great deal either of zinc or copper in that bottle, we can reduce its bulk by heating it, and then at a certain temperature the zinc becomes exceedingly brittle, and falls to the bottom. All this time dry carbonic acid is passing through. You see now that the metal is reduced considerably in bulk, because most of it is broken down into powder; and we can use this powder as we wish, and weigh it out as we want it. [A portion of the powder was removed from the flask.] There, you perceive, is the most intimate mixture of zinc and copper which one can well conceive. This is our zinc couple, and it is prepared to act upon any substance—to act like the zinc and copper plates, only there the copper and zinc were at about the distance of 10 inches; here they are touching one another—touching at myriads of points. There the zinc and copper had to be brought into connection by means of another piece of metal, while here they are already in connection with one another. They are touching one another, and the liquid is touching them, so that instead of having one large cell with a large amount of resistance, we have a cell in which the resistance is reduced to an infinitesimal quantity, because the liquid completely surrounds the two metals, touching them at the points that are most important—the points of junction. Hence the power of the two metals, whatever we call it,—the chemical power or the electromotive power,—is exerted at the best possible advantage.

We may now take substances like water or chloroform, which offer a very great resistance, and, by using this metallic powder, tear them asunder better than with all the batteries that can be invented—better than by all the galvanic apparatus which are in this institution, or in any of the institutions in London.

(To be continued)

CHEMISTRY APPLIED TO THE DETECTION OF ADULTERATION.

By ALFRED H. ALLEN, F.C.S.,
Lecturer on Chemistry at Sheffield School of Medicine; Public Analyst for North Derbyshire and the Borough of Sheffield.

(Continued from vol. xxx., p. 117.)*

IV. Butter.

Although the number of the constituents of butter is but small, and their nature has long been well understood, the examination of butter for the detection of adulteration is surrounded with peculiar difficulties, the principal of which has only been overcome quite recently.

As commonly sold, butter consists of the fatty matter of the milk of the cow, together with very variable quantities of salt, water, and the different constituents of milk. Genuine butter should be composed wholly of the above constituents, and all other substances (except, perhaps, harmless vegetable colouring matters) must be regarded as adulterants.

But it does not follow that butter which only contains the usual ingredients is necessarily unadulterated in the proper sense of the term. The presence of excessive proportions of curd, water, or salt must be denounced.

In the process of making butter, it is usual to wash the separated fat with water, to free it as much as possible from buttermilk, &c., though in some cases this process is omitted, and the aqueous portion of the butter is practically the serum of milk. A small proportion of casein or curd must be considered a normal constituent of butter, but it is said to be sometimes employed as a vehicle for an excess of water. The same remark applies to salt.

The proportion of water in well made butter is generally about 8 or 10 per cent; it ought not to exceed 12 or 13 per cent. The proportion of salt varies greatly according to the character of the butter, the amount in fresh butter being often less than 1 per cent, while in good salt butter it amounts to from 5 to 8 per cent. Any proportion greatly in excess of the latter amount is suspicious, and if it exceed 10 per cent, special notice should be taken of it. The curd consists of the caseous matter of the cream, and must be considered as a decidedly objectionable constituent of butter, as its presence promotes decomposition. Butter which has been completely freed from casein and membrane by fusion may be kept unaltered for years. The proportion of curd in butter should not exceed 5 per cent. If sensibly in excess of this amount, it should be considered as an adulterant, as it has probably been left in or added with the view of causing the butter to retain more water.

It is evident that the question of adulteration of butter by excess of water, curd, or salt is dependent on the aggregate amount of the three, or, in other words, upon the percentage of real butter-fat present in the sample. This, in genuine butter, is less variable than might be supposed. In twelve genuine butters from different sources, Messrs. Angell and Hehner† found an amount of fat varying from 78·491 to 90·197. With one exception, there was no butter which contained less than 83·68. The average of the twelve was 85·45 per cent of fat. The above estimations appear to have been made indirectly, by subtracting the sum of the percentages of water, curd, and salt from 100,000.

The Society of Public Analysts has adopted 80·00 per cent as the lowest limit of fat contained in a genuine butter.

The amount of *water* is best ascertained by heating 5 grms. of the butter in a small weighed beaker to a temperature of about 110° or 120° C. for an hour or so. Some chemists merely heat the butter on a water-bath. Accord-

* The Author regrets that indifferent health and professional engagements have together caused the lapse of so long an interval of time since the appearance of his late article. He hopes to avoid similar delay in the future.

† "Butter and its Adulterations," pp. 14 *et seq.*

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ing to my experience, perfect drying is next to impossible at that temperature.

It has been proposed to estimate the water by measurement after melting a weighed quantity of the butter in a graduated tube. This exceedingly simple method, which answers perfectly with lard, is useless in the case of butter, in consequence of the casein floating between the melted fat and the water, and rendering it impossible to observe the line of demarcation. I have tried several varieties of the proposed method with uniform failure. The ingenious plan of Hoorn,* who uses petroleum ether, fails for a similar reason. Solution of the butter in ether, with subsequent addition of petroleum ether (commercial "benzolene"), answers somewhat better, but is unsatisfactory. The estimation of the water in butter by drying is the only known method which, according to my experience, is capable of giving reliable results.

The dried butter is next treated in the beaker with anhydrous ether or commercial benzolene. The former liquid is expensive and inconveniently volatile, while it must be used in a perfectly anhydrous condition (to avoid solution of the salt), and, except when boiling, has but a limited solvent power for butter, especially when adulterated. Benzolene dissolves fats more readily than ether; it does not volatilise so rapidly at ordinary temperatures, it is always anhydrous, and has the advantage of low price. The "benzolene" I employ is made by re-distilling the commercial article from a retort immersed in a bath of boiling water. About one-third of the original bulk usually comes over readily at 100° C., and has a gravity of 0·689.

On warming the beaker containing the benzolene, the dry butter readily dissolves. The liquid is poured on a small dry filter, and washed with warm benzolene, the filtrate being collected in a small wide beaker.

If the filter had been previously weighed, its increase of weight, after careful drying, will of course give the quantity of *curd and salt* in the 5 grms. of butter taken. Except in cases in which extreme accuracy is desired, I prefer to scrape the residue off the filter, and weigh it separately.† The error (owing to imperfect removal) only amounts to one or two tenths per cent of the butter taken. As the salt is accurately estimated afterwards the loss falls on the curd. The *salt* may be determined by careful ignition of the filter and residue, the incombustible matter consisting almost wholly of common salt, while the *curd* is ascertained by the loss of weight. This method is not to be recommended, for, without great care, some of the salt will be volatilised and lost, the error causing the amount of curd to appear excessive.‡

Ignition also renders any further examination of the curd an impossibility. A far preferable plan is to return the weighed curd and salt to the filter, and to wash them with cold water. The filtrate is made up to 100 c.c., and the salt estimated in half of it by titrating with decinormal nitrate of silver. The remaining portion of the solution can be employed for the estimation of *sugar* if desired. This is effected by inverse titration with Fehling's copper solution in the same way as grape-sugar.

The estimation of sugar may sometimes be of interest as a means of ascertaining whether the aqueous portion of the butter consisted of mere water or of serum of milk. In other words, the estimation of the sugar may furnish a means of ascertaining whether an excess of water in the butter is due to insufficient removal of the buttermilk, or to subsequent incorporation of water. Every 0·001 grm. of milk-sugar represents about 0·022 of average milk serum.

The residue insoluble in cold water usually consists almost wholly of *casein*. If, however, the butter has been adulterated with mashed potatoes, flour, or other *starchy matters*—said to be occasionally employed—they will be found here. The presence of starch in the residue will, of course, be readily indicated by treating it with hot water, and testing the cooled liquid with solution of iodine. Starchy matters can also be detected by stirring up the butter itself with solution of iodine. By pressing out a small portion of the butter between two slips of glass so as to obtain a thin film, and observing it under the microscope (or by observing the caseous residue after treatment with cold water), the nature of the starch may be ascertained.

The solution of the fatty matter in benzolene is evaporated at 100° C. till it no longer decreases in weight. The average proportion of *fatty matter* in butter is about 85 per cent. If less than 80 per cent, the butter must be considered adulterated. It is evident that a careful estimation of the percentage of fatty matter would often render separate estimations of the water, curd, and salt unnecessary, for unless the sum of the three latter constituents exceeded 20 per cent the butter could not be considered as adulterated, unless by an admixture of other fats.

An easy and rapid method of estimating the fat in the undried butter is therefore a great desideratum, but, unfortunately, no satisfactory method is at present known. I have tried a plan which seemed exceedingly promising, and which consisted in merely treating the butter with petroleum ether, filtering, and evaporating the solution of the fat. The process was a failure, owing to the fact that the water passed through the Swedish filter employed, even where the latter was thoroughly drenched with benzolene.*

The indirect estimation of the fat, by subtracting the sum of the percentages of water, curd, and salt from 100·00, ought to agree with the direct estimation of the fat within 0·5 per cent, and the variation is often much less.

(To be continued.)

* *Zeitschr. Anal. Chem.*, vol. xi., p. 334; and *Journ. Chem. Soc.*, 1873, p. 1064.

† The removal of the residue from the filter presents no difficulty if the butter has been properly dried. In the presence of water it is impracticable.

‡ Dr. Tidy estimates the salt by igniting the butter itself. This method is still more liable to error from volatilisation unless great care is taken.

* A similar, but reverse, action has been observed to occur if the insoluble fatty acids from butter be washed with boiling water on a Swedish filter provided with a hot-water jacket, the fats passing through the wet filter simultaneously with the water. At a slightly lower temperature, such as obtains in practice by omitting the water jacket, no such effect is observed.

† "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

‡ Andrews, *Nature*, 1875, p. 365.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.†

By Dr. A. W. HOFMANN.

(Continued from p. 65.)

THE discovery made known by Schönbein, according to which the peculiar phosphorous odour accompanying the electrolysis of water was due to the evolution of oxygen in a state possessing heightened oxidising properties, was received with great expectations, both in medicine and arts. Schönbein named this oxidising principle ozone (from ὀζειν, to smell), and he perceived its evolution, as Van Marum had already done in 1785, at least, as far as the odour is concerned, near the conductor of an electric machine when in action. He discovered subsequently that it was produced also during the slow combustion of phosphorus, and that it was present in the atmosphere in very perceptible traces. Observations of its occurrence increased very rapidly. Schönbein and others found that the peroxides of silver, barium, and hydrogen, in contact with sulphuric acid, evolved oxygen more or less strongly ozonised, the same property belonging also to the manganate, permanganate, and (according to Rammelsberg) the periodate of potash. The agitation of air with mercury, or with the precious metals in a state of fine division, or with powdered glass,‡ was also found

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to be a means of ozonisation. The ethereal oils, especially oil of turpentine, display this property in a high degree. Ozone was detected in the air current from a furnace-blast and in the oxygen expired by plants.

The means for its detection, in addition to the fact that 1 part of ozone imparts its peculiar odour to 500,000 parts of air, were found in the following reactions:—

Ozone liberates iodine from iodide of potassium, iodic acid and potassic peroxide being simultaneously formed, and the solution, after the removal of the iodine, has an alkaline reaction. The presence of the free iodine is easily demonstrated by means of moist starch-paper, and the potash, or potassium peroxide, by litmus. Ozone bleaches indigo and colours freshly-prepared tincture of guaiacum a deep blue, turns paper brown which is saturated with salts of manganous oxide or thallous salts by the formation of higher oxides, oxidises mercury at ordinary temperatures, and converts silver into black silver peroxide. Paper saturated with thallous oxide and exposed to ozone blues tincture of guaiacum, potassium-iodide, and starch before it turns brown. It was sometimes forgotten that the reactions with indigo, guaiacum, and iodide of potassium and starch are produced also by chlorine, nitrous and hyponitrous acid, and hence phenomena have been ascribed to ozone which were really due to one or other of these bodies.

Concerning the nature of ozone, opinion fluctuated for a long time. More than one eminent chemist held that it contained hydrogen. Marignac and De la Rive maintained the opposite view, which was finally demonstrated by Soret in 1863. The reason of the difference between ozone and ordinary oxygen became gradually intelligible. The first step was furnished by the observation of Andrews and Tait that ozonised oxygen if heated to 270°, was converted into common oxygen, increasing at the same time in volume, and that ordinary oxygen, if ozonised by silent electric discharge decreased in volume. This decrease in bulk corresponds to the quantity of the active oxygen absorbed by potassium iodide, so that if the volume, on ozonisation, is decreased by $\frac{1}{n}$, then $\frac{1}{n}$ of the ozonised oxygen is absorbed by solution of potassium iodide. Ozone, therefore, appears indubitably as condensed oxygen. Odling's hypothesis that this condensation amounts to one-third, and that the molecule of ozone is larger by the half than that of ordinary oxygen, its molecular weight being $O_3=48$, that of common oxygen being $O_2=32$, was approximately proved by Soret in 1865, and decidedly demonstrated by Brodie in 1871.* Soret added the discovery that ethereal oils, especially oils of turpentine and of cinnamon, absorb the whole amount of the ozone formed; consequently, not $\frac{1}{n}$, but $\frac{3}{n}$.

(To be continued.)

COAL IN RUSSIA.

(Analyses of some Samples).

By SERGIUS KERN, St. Petersburg.

In the Chemical News (vol. xxxi., p. 133) I gave some analyses of Russian coals; I suppose a further description of some other samples may be of some interest.

Government Toula.—

1. Village Kievtzi on the river Oka; 3000 calorific units; 3·07 per cent of sulphur:—

	Per cent.
Carbon	22·54
Volatile matter	27·78
Ash	49·68
	100·00

2. Village Krasni Cholmi; 4000 calorific units:—

	Per cent.
Carbon	52·00
Volatile matter	31·32
Ash	16·68
	100·00

3. Village Vialino in the Odoievsky district; 4000 calorific units; 2·13 per cent of sulphur:—

	Per cent.
Carbon	39·68
Volatile matter	52·40
Ash	7·92
	100·00

4. Village Malëvka in the Bogoroditsk district; 3500 calorific units; contains 32 per cent of hygroscopic water:—

	Per cent.
Carbon	34·88
Volatile matter	42·76
Ash	22·36
	100·00

Government Kalouga.—

5. Village Zelenino; 3560 calorific units; absence of sulphur:—

	Per cent.
Carbon	30·35
Volatile matter	48·36
Ash	21·29
	100·00

6. Village Znamensky in the Likhvin district; 4200 calorific units; fresh coal contains 20·05 of hygroscopic water:—

	Per cent.
Carbon	35·70
Volatile matter	44·24
Ash	20·06
	100·00

Government Ekaterinoslaw.—

7. Near the Village of Mr. Illovaiski; calcined, leaves 74·70 per cent of compact coke; 6900 calorific units; sp. gr. 1·26; 10,600 cubic feet of gas per ton:—

	Per cent.
Carbon	72·22
Volatile matter	24·47
Ash	2·48
Hygroscopic water	0·83
	100·00

Government Simbirsk.—

8. Near the town Sysrane on the river Volga; 3500 calorific units; bad coal:—

	Per cent
Carbon	17·20
Volatile matter	37·30
Earthy matter	28·40
Hygroscopic water	17·10
	100·00

Caucasus.—

9. On the rivers Coubane and Choumar; the coal gives compact coke; 7000 calorific units:—

	Per cent.
Carbon	58·85
Volatile matter	37·99
Ash	3·16
	100·00

* Brodie, *Proceedings of the Royal Society*, vol. xx., p. 472, 1872; Odling, "History of Ozone," *Proceedings of the Royal Institution*, 1872.

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Donetz Mountains.—

10. On the river Bolshaia-Nesvitaia; good anthracite; 7600 calorific units; 0·27 per cent of sulphur:—

	Per cent.
Carbon	93·27
Volatile matter	4·92
Ash	1·81
	100·00

SOCIETY OF PUBLIC ANALYSTS.

The "Sale of Food and Drugs Act, 1875," received the Royal Assent on the 11th inst., the whole of the amendments introduced by the House of Lords being at length accepted by the Commons. We hope at an early date to publish a short *resumé* of the Bill, pointing out its probable working, and the necessary changes and modincations in the machinery.

A NEW DEFENCE FOR MILK ADULTERATORS.

Recently, in a prosecution for milk adulteration, instituted on the certificate of Mr. W. Morgan, Ph.D., the Public Analyst for the Borough of Swansea, the adulteration was denied; and, in explanation of the poverty of the milk, it was urged that it had been taken from a cow a few hours only after she had been milked dry. This being a new line of defence, Mr. Morgan instituted a series of experiments for the purpose of ascertaining whether, under even the most trying circumstances, the "solids not fat" would fall below the Society's standard.

The tabulated results of Mr. Morgan's experiments we print below, feeling sure they will be of interest to all engaged in milk analysis.

It may be well just to mention that the cow was kept indoors during the time these experiments were being performed; that it was fed chiefly on brewer's grains, together with a little barley meal, &c.; that it was an ordinary black cow, the worst the dairyman had; that it had calved about six months previously; that the udder was in each case exhausted; and that all the milkings were done in Mr. Morgan's presence.

Date.	Hour of Milking.	Total Quantity.	Percentge. of Cream after 24 hours.	Total Solids.	Fat.	Solids not Fat.	Ash
July 6 ..	6.30 a.m.	7½ pints	13	12·84	2·96	9·88	0·63
„ „ ..	7.30 „	6 ozs.	37	17·00	8·00	9 00	0·65
„ 17..	6.30 „	7½ pints	13	12·68	3·48	9·20	0·73
„ „ ..	8 30 „	6 ozs.	33	16 56	7·00	9·56	0·07
„ 18..	6 45 „	7½ pints	14	13·16	3·78	9·38	0·73
„ „ ..	9.45 „	4 ozs	24	15·23	5·89	9·34	0·72
„ 19..	6.30 „	7½ pints	15	13 15	3·62	9 53	0 64
„ „ ..	10 30 „	2 „	21	15·41	5·46	9 95	0·72
„ 20..	6.30 „	8 „	12½	12·59	3·13	9 46	0·03
„ „ ..	11.30 „	2½ „	17	14·31	4·51	9·80	0·70
„ 21..	6.45 „	6 „	10	12 70	3·10	9·60	0·68
„ „ ..	12.40 p.m.	2 „	15	14·20	4·32	9 88	0·73
„ 22..	6.30 a.m.	6 „	15	13·29	3·70	9·59	0·80
„ „ ..	1.30 p.m.	3 „	17	14·45	4 90	9·58	0·70
„ 23..	6.45 a.m.	7½ „	12	12 60	3·03	9·57	0 80
„ „ ..	2.45 p.m.	3½ „	15	13·82	4·54	9·28	0·75
„ 24..	6.45 a.m.	7½ „	12	12·62	3·24	9·38	0·72
„ „ ..	3·35 p.m.	4½ „	20	13·53	4·10	9·43	0·69

The above table shows that the eighteen milkings yield the following results:—

Total Solids—

Highest*	17·60
Lowest	12·59
Average..	13·93

Fat—

Highest*	8·60
Lowest	2·96
Average..	4·41

Solids not Fat—

Highest	9·95
Lowest*..	9·00
Average..	9·52

* These being from the same milk.

The next ordinary meeting will be held in the Museum and Library, Bristol, on Thursday next, the 26th inst., at 4 o'clock p.m. Papers on various subjects will be read and discussed, and the "Sale of Food and Drugs Act" will be fully considered.

NOTICES OF BOOKS.

How to Teach Chemistry, being the substance of Six Lectures Delivered at the Royal College of Chemistry in June, 1872, by E. Frankland, F.R.S., &c. Summarised and edited by G. Chaloner, F.C.S., Lecturer on Chemistry at the Birkbeck Institute. London: J. and A. Churchill.

We have often had occasion to notice the number of elementary works on chemistry issued from the English press—a supply rather disproportioned in amount to our quota of original investigation. Indeed, we half fear the time may come when the production of some such "manual" or handbook will rank as a matter of course among the youthful indiscretions of every man of culture. Some of these treatises may deal mainly in facts, whilst others indulge more largely in theory. Some may regard chemistry mainly as a field for the display of an ultra-sesquipedalian terminology, whilst some hold that a chemical compound, like a rose, will "smell as sweet by any name," and designate every substance by the briefest combination of letters needful for its identification. But beneath all these surface diversities there necessarily lies a mass of matter incontrovertible—if anything may claim such a title—and common to all. Hence, there remain for the critic merely questions of arrangement, or of lucidity of exposition, and he is often at a loss to imagine why nine out of every ten such books were ever written.

The treatise before us takes, however, a higher aim. It is addressed, primarily, not to the student, but to the professor. It instructs him *how* to teach chemistry; or, if we may so word it, what to teach as chemistry. This is really a point of no small moment. A most profound chemist may be injudicious in his way of imparting knowledge to others. Further, in these days, we learn, as was recently stated on high authority, "not to know, but to pass." Now, it is quite possible that a chemist, especially if of original and independent mind, may overlook this circumstance. He may forget that science, like millinery has its fashions, and like politics, its party-shibboleths and he may hence find that his pupils fail to pass to his own discredit and to their disadvantage. Hence, it must be admitted that a work like the one in question has an indisputable value.

As an important feature we notice a collection of "systematic names," and of "trivial names" placed in parallel columns. We have often thought that a dictionary of chemical terminology is fast becoming one of the wants of the age. But we cannot congratulate the authors on the manner in which the idea has been carried out. Their "trivial" names are a mixture of systematic names not now in fashion, of alchemical, pharmaceutical, and trade terms, and of the scientific names of mineral species, all used indiscriminately. Thus, malachite is given as the "trivial" synonym for cupric carbonate. We hope that the science-teachers for whom the book is intended are aware that malachite is the mineralogical name of one particular form in which cupric carbonate occurs in nature. In like manner spathic iron-ore is here given as a trivial synonym for ferrous carbonate, silver

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glance for argentic sulphide, and white lead ore for plumbic carbonate.

Again, we find saleratus (? salæratum) given as synonymous with hydric potassic carbonate. Saleratus, salaratus, or salæratus is a word not in vogue n England, but when used it is applied—as it generally is in America—to the salt lately known as bicarbonate of soda. In like manner salenixum, though once used for hydropotassic sulphate (bisulphate of potash), is now commonly applied to sulphate of soda, and is corrupted by the dyers into "Sally Nixon."

The following passage is worthy of notice:—"It is remarkable how students at the May examination, 1870, misunderstood the first question in the paper: 'You have given to you some sulphur, water, and nitric acid; describe how you would make sulphuric acid from these materials?' The question obviously (?) referred to the oxidation of sulphurous anhydride by means of nitric acid. Yet the majority of the candidates who attempted it gave a long account of the manufacture of sulphuric acid, with all the details which they could recollect of the lead in chambers, &c. This gives a striking illustration of the necessity of intelligence as well as information to enable a student to come out well in an examination. Not only ability to *answer* a question, but to *understand* it first is wanted."

The ability to answer a question unless it is first understood seems to us somewhat rare. But should not examiners seek to put their questions in language not susceptible of a double meaning? If from loose and vague habits of thought on their own part or from a latent desire to puzzle they utter ambiguities, they commit a grievous wrong. A chemical examination should test the standing of the student in chemistry, and not his power of guessing ancient oracles or modern conundrums.

Programme of the Royal Rhenish Westphalian Polytechnic School at Aachen for the course 1875-76.* Aachen: J. J. Beaufort.

Whilst we in England are disputing about the best means of imparting a mere elementary education, or rather how such an education may be made to subserve the ends of certain classes and certain parties, Germany, more fortunate, or more prudent, is, in institutions like the Polytechnic School of Aachen, training up inventors and discoverers, or, to say the least, improvers. In other words, she is placing sound instruction in the scientific principles which underlie the arts and manufacturers within the reach of all. If the greatness, the wealth, and the progress of nations depends in the last resort, upon invention and discovery, Germany possesses in such schools the springs of a power more redoubtable even than her armies.

The Polytechnic School of Aachen was opened in October, 1870, for the purpose of affording "a comprehensive theoretical and practical training to young men who wish to devote themselves to technology, especially to machine making, the chemical trades, metallurgy, engineering, and architecture." Recognising the necessity for a division of labour, and seeking to develop thorough specialists, "männer vom fach," rather than "Jacks of all trades and masters of none," the college does not compel all its students to pass through one and the same stereotyped course of education. It has a separate curriculum for the engineer, the metallurgist, the chemist, &c. As regards the facilities offered we may mention that in the chemical laboratory there is room for 110 students to work. In addition to the scope thus afforded for practice in analysis and in original research,—which is encouraged—there are courses of lectures, not merely on pure chemistry, organic and inorganic, on analytical chemistry, technical chemistry, on arranging chemical works, but on the polarisation of light, on spectrum-analysis, on theoretical chemistry, on saccharimetry with practical training, on the analysis of coal-gas, on forensic chemistry and toxicology, on brewing, on the sugar manufacture, and on dyeing and calico-printing. Further, arrangements are made for the students to visit eminent chemical works. Thus, during the past year excursions were made to the sugar-works of Cöln, Düren, and Elsderf; the breweries of Aachen and Dortmünd, the glass-works of Stolberg, Cöln, Aachen, and Herzogenrath, the tar-works of Mülheim, the mirror-works of Stolberg and Herzogenrath, the anilin-colour works of Elberfeld, the silk-dye works of Crefeld, &c.

The question now arises, What is the cost of a scientific training so comprehensive and so thorough, conducted by professors of tried merit? As closely as we can calculate, if the student attends the greatest possible number of lectures and lessons, he will pay, for the term of ten months, from October to the end of July, fees amounting to 180 marks or about £9. If we add to this £2 5s., the yearly charge for working in the laboratory, we find the whole college expenses more than covered by the sum of £12 yearly. Have we any establishment in England where similar advantages can be obtained for five times that amount? Surely such facts must go far to explain how it is that leading positions, not merely in our colleges, but in our manufacturing establishments are being filled by foreigners, to the exclusion of natives. Is there no "Cassandra" to enlarge on this theme?

Plattner's Manual of Qualitative and Quantitative Analysis with the Blowpipe. Revised and enlarged by Prof. Th. Richter, (Royal Saxon Mining Academy, Freiberg). Edited by T. H. Cookesley. London: Chatto and Windus.

Our opinion on the merits of Plattner's great work has been often enough expressed. But when we remember the existence of two formal English versions of the manual—those of Muspratt and Cornwall—to say nothing of sundry adaptations and abridgments, we can only say that we hope the editor and publishers will not be disappointed in their expectations. Mr. Cookesley informs us in his preface that he has followed generally the translation of the American edition, omitting some few portions which he thought superfluous, such as the lists of minerals given under each heading.

CORRESPONDENCE.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—In reference to the observations on this subject by my friend Mr. Readwin, published in the Chemical News (vol. xxxii., p. 71) I crave permission to call attention to a slight oversight. The writer asserts that in this country we "never had a distinctive Society of Mineralogists." It may therefore be worth while to mention that a "British Mineralogical Society" existed in the early part of this century, although its history appears to be not generally known. The original minute book is, however, preserved in the Library of the Royal School of Mines, and the origin of the Society is set forth in the first entry as follows:—"At a meeting held in the Askesian Society's room, Plough Court, April 2, 1799; present, Wm. Allen, W. H. Pepys, Alex. Tilloch, Rd. Knight, and Wm. Lowrey. Resolved that those present do form themselves into a Society under the denomination of the British Mineralogical Society." On this resolution action was at once taken, and the Society was founded. From the minutes of the fortnightly meetings it is clear that the members, though few, were banded together for real work. Minerals were received by the Society, and distributed

* *Program der königlichen rheinisch westfälischen Polytechnischen Schule zu Aachen für den Cursus 1875-76.*

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among the members, who were compelled, under penalty of a fine, to examine them and report the results to the Society. In this way a good deal of original work was got through; but it appears that pure mineralogy was not sufficient to keep the Society in healthy activity, and admission was consequently given to subjects relating to general chemistry and even to geology. It must be borne in mind, however, that in those days there was neither Chemical nor Geological Society. After about the fifth year of its existence, the minutes of the Mineralogical Society became less interesting, and its life was slowly ebbing away, so that we are not surprised to find the following minute recording the close of its individual history:—"London, December 18, 1806; present, Wm. Allen, Rt. Bingley, Rd. Phillips, Rd. Knight, W. H. Pepys, and Thos. Cock. The Committee appointed to confer with the Askesian Committee having recommended the union of the two societies (*sic*) as advantageous to each in their design of promoting philosophical research, it was resolved that the societies be incorporated, which W. H. Pepys was desired to communicate to the Askesian Society."—I am, &c.,

F. W. Rudler.

London, August 16, 1875.

LEAD IN DISTILLED WATER.

To the Editor of the Chemical News.

Sir,—Some time ago I fitted up a small glass apparatus for distilling water, using a piece of 2-inch English glass tubing for a condenser. After six or eight months the distilled water obtained was found to contain large quantities of a lead compound in solution, and on examining the condenser I found it encrusted with crystals of a basic plumbic carbonate. The English glass tube was found to contain a large quantity of Pb existing as silicate. Under the combined influence of steam and CO_2 at an elevated temperature this plumbic silicate was decomposed; formation basic carbonate and separation SiO_2. The basic carbonate then dissolved in the water (which contained CO_2) as it condensed.—I am, &c.,

W. C. Parsons.

CALCULATION OF THE PROPORTION OF LIME IN MORTARS.

To the Editor of the Chemical News.

Sir,—In your notice of Major Ross's work on "Pyrology" there is an extract which is likely to give incorrect notions as to the composition of the mortar used in Indian Government buildings. If, as is probable, the 8 or 9 per cent of lime in the mortar of the Agra barracks, and the 5 per cent in that of the Allahabad building, are percentages by weight, the statement requires some remarks before presentation to persons not practically acquainted with the preparation of mortar.

I may first remark that mortar being invariably made with sand and lime can hardly be described as "mud." And a contractor intending to cheat in the matter of lime will take care that the sand shall be real sand; for an engineer who is not very knowing in the matter of lime will probably be inversely particular in seeing that the sand is "sharp and clean." It is also hinted that to the use of "kunkur mortar" is to be ascribed the ruin of many millions worth of public buildings.

Now this "kunkur," from which lime is nearly always obtained in the interior of India, is a conglomerate limestone formed by the hardening and crystallisation of carbonate of lime deposited from water. It may be nearly pure hard chalk, or it may contain as much as 30 per cent, or more, of sand, clay, disintegrated gneiss, &c. When clayey, and of decidedly nodular structure (resembling somewhat the *septaria* from which Roman cement is made) it yields, on burning, a lime which, under proper treatment, is of excellent hydraulic quality. The proportion of clay and other impurities is always much greater than in an European limestone of equal hydraulic quality. The proportion of impurity increases of course when the stone is burnt: a limestone containing 20 per cent will yield a lime containing 30 per cent. A good and typical kunkur lime, fresh burnt, was found to contain—

Silicates (sand, clay, &c.) ..	40·0 per cent.
Unburnt carbonate of lime..	8·8 ,,
CaO	51·2 ,,

This lime, so impure as to contain only one-half of real CaO, yet was of excellent hydraulic quality. A paste or a mortar made with it set (*i.e.*, supported Vicat's needle) under water in four days. The lime on being slaked increased one half, its specific gravity in bulk diminishing from about 1 to 0·67.

The engineer will probably be satisfied if 1 volume of the slaked lime be mixed with 2 volumes of sand (of which the specific gravity is 1·5); we shall thus have as the composition of the mortar, calculated on the dry materials—

1 vol. lime, weighing	0·67	0·33 silicates. 0·34 lime.
2 vols. sand, weighing	3·00	
	3·67	

So 3·67 parts by weight of dry mortar contain only 0·34 part, or somewhat under 10 per cent of real CaO. I have not made any allowance for increase of weight in slaking or for absorption of carbonic acid by the mortar in drying, both of which would tend to diminish the proportion of lime.

Now this mortar, yielding on analysis less than 10 per cent of lime, will be of excellent quality if properly made, and mortar, like paint, requires to be mixed with brains. Bricks united with it, and placed *at once* under water, will be found, after one month's immersion, to adhere with a strength of at least 15 lbs. per square inch, the brick itself ripping under a strain of little over 20 lbs. per square inch.

Supposing that the mortar has been made from a good fat lime containing not more than 10 per cent of impurity, and swelling to double its volume on slaking, the composition would have been—

1 vol. slaked lime, weighing	0·50	0·05 silicates. 0·45 lime.
2 vols. sand, weighing ..	3·00	
	3·50	

This mortar will contain, then, in 3·50 parts 0·45 part actual CaO, or about 13 per cent: it would appear most satisfactory to the engineer, but bricks united with it would yield at a strain of about 4 lbs. per square inch, and it would be absolutely devoid of hydraulic properties. Indeed, for dry work, bricks, laid in mud and the joints neatly pointed, would be rather stronger than bricks in this mortar; and no increase in the proportion of lime would be of the slightest advantage.

In fine, a mortar found to contain rather less than 10 per cent of actual lime in the dry materials may be of excellent quality, while one containing 13 per cent, or even 25 per cent, might be very bad. It is on the quality of the lime used for the mortar, and not on the quantity of CaO contained in it, that the strength of the mortar depends. Analysis alone will rarely give any trustworthy indications on this point.

I have no doubt that the bad quality of mortar has had much to do with the ruins to be found in Indian cantonments. I have myself seen a costly public building condemned as dangerous, and pulled down, before it had been put to any use. But I think I have shown that there are different kinds of bad quality, and low percentage of CaO is not the only one—deficiency of mortar itself and the use of fat lime are quite as great faults. The first two these defects are part and parcel of the "scamped" work which so often occurs under the contract system of building in India; nothing but superintendence by vigilant and

incorruptible overseers will prevent them; the last defect has been under the attention of the Indian Government. I was engaged for two years in an inquiry on the subject, and the results may be found embodied in the Madras Government Orders, P.W.D., February 21 and December 10, 1874. The details of the inquiry are mostly too technical for reproduction in your columns. I will only state that in publishing my reports the Madras Government "anticipate that a marked improvement in the selection and preparation of cements and mortars for different descriptions of public works will result."—I am, &c.,

EDWARD NICHOLSON.

Carlisle Castle, August 9, 1874.

THE PYROXIDATION OF SILVER.

To the Editor of the Chemical News.

SIR,—I ought to be, and am, the last to cavil at any expressions of the able, candid, and, at the same time, generous review of my lately-published book, "Pyrology, or Fire Chemistry," which appeared in the CHEMICAL NEWS, vol. xxxii., p. 59, but it seems to me that a citation from the former in the latter is the result of a misapprehension.

I refer to this sentence:—"In a subsequent portion of the work, the author remarks that the volatility of silver at high temperatures is not unknown in Germany. We can assure him that, among assayers and metallurgists, it is not unknown in England also."

Now, on referring to my book (page 248 *et seq.*), it seems to me that my remarks of that complexion were made with reference, not to the *volatilisation*, but the *pyroxidation* of silver. I admit that there is some confusion existing between the use of these two terms, and even that it it is somewhat apparent in the article on silver in my work; but it is not due to me, the latter term having never, so far as I am aware, been employed at all before I used it.

Yet it is evident that these terms are by no means synonymous. Mercury, for instance, is volatilised by the most moderate heat in the shape of a *metallic* sublimate, which consists of myriad particles, or, more correctly speaking, globules so minute that they have, without investigation through a microscope, the *appearance* of a white powder or coating, or pyroxide, which, however, when scraped together with the back of a penknife, congests again into visible balls of mercury; this, therefore, may be cited as a good illustration of a volatile *metal*. Arsenic or antimony, on the other hand, do not volatilise *metallically* on being heated, but in the shape of oxides (arsenious and antimonious acids). You may say "What is the use of telling us such well-known facts?" and if so, I reply—"In order to carefully distinguish between *metallic volatilisation* and *pyroxidation*."

Now, I maintain that English chemists have never (in print) noticed the fact of the *pyroxidation* of silver before the blowpipe, and that the German chemists, especially Plattner, have. In fact, I have cited as proof of the first assertion in my article on silver, the remark of Professor Bloxam, that "silver is not capable of undergoing oxidation in the air *under any circumstances*," and of Dr. Percy's letter to me in 1874, that "I do not believe in the silver oxide which you mention, nor in certain experiments of Plattner, in which he supposed he had proved the existence of volatile oxide of silver."

In spite of the formidable authority of the latter gentleman, and of the decided tone in which his opinion is expressed, I submit that if we fuse, before a pyrogene or blowpipe, the smallest proportion of silver in lead or any silver ore, or, in short, any substance affording under such conditions a sublimate, and containing the minutest trace of silver, there will be a "rose" or bluish violet tinge to that sublimate, or part of it, in proportion to the quantity of silver present, and that, if there be no silver present, we shall have no such tinge. So much is easily observable even on charcoal; on aluminium plate the reaction is intense. Plattner says (page 402) of the coating on charcoal, "this reddening of the coat is highly characteristic, and may always be regarded as indicating silver."

It will scarcely, I presume, be argued that this "red" substance is volatilised silver, and not a pyroxide, and although it can be proved (as I have shown in my book) that it is not due to silver at all, but to *gold*, it is, as Plattner says, a certain indication of the former metal, which *invariably* affords it under such treatment, having *also*, as may be readily seen by the operator who uses aluminium as a support, a pyroxide of its own of a golden bronze tint (see page 252 of my work), not so easily recognised in presence of plumbic, &c., sublimate as the pink one. Another question of great importance is raised by the investigation of the former one. Is the green "flame" observed on heating silver before a blowpipe, which affords the two lines "in the green" of the solar spectrum, due to the combustion of volatilised silver or to that of argentic pyroxide? Although such an opinion is contrary to the acepted theories of spectrum analysis, I maintain that it is due to the latter, for if we heat a ball of silver so that the green "flame" impinges upon aluminium plate behind it, we find, at the exact point of contact, the golden bronze coating above mentioned, a little of which scraped off and gently heated in boric or phosphoric acid, gives the reactions of *oxide* of silver, but no trace of the *metal*.—I am, &c.,

W. A. ROSS.

London, August, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, tome lxxxi., No. 3, July 19, 1875.

Distinction between Natural and Artificial Organic Products.—M. L. Pasteur.—The author maintains, in opposition to M. Schützenberger, that all the artificial products of the laboratory have a superposable image, whilst most natural organic products are dissymmetrical, and in consequence of this dissymmetry their image cannot be superposed upon themselves, and that not a single optically inactive body has been rendered active by the reactions of the laboratory.

Note on Magnetism: Reply to an Observation of M. Jamin.—J. M. Gaugain.—In his paper of June 3rd M. Jamin states that he has selected for certain researches the method proposed in 1849 by Van Rees, and adds—"This method has been adopted without modification by M. Gaugain, who admits the principle without having demonstrated it any more than had been done by Van Rees." To this M. Gaugain answers that he has not precisely adopted, but rather re-discovered the method in question.

Oxuvitic Acid, and the Cresol Derived from it.—MM. Oppenheim and S. Pfaff.—Oxuvitic acid results from the action of chloroform upon sodic acetic ether. The same acid is formed by the action of chloral, trichloracetic ether, and tetrachloride of carbon upon the same ether. On distilling with an excess of lime, and in small portions, 800 grms. oxuvitate of baryta, and 360 grms. oxuvitate of lime, the authors obtained more than 150 grms. of pure cresol. This is meta-cresol.

Compound of Methylic Oxide and Hydrochloric Acid.—M. C. Friedel.—On passing into a receiver, imbedded in a freezing mixture, a mixture of methyl oxide and of hydrochloric acid, pure and dry, there is condensed a colourless mobile liquid, which fumes on exposure to the air, and distils over between $-3°$ and $-1°$. It is a body analogous to the known compounds of ether with metallic

chlorides, and to those of ethyl-oxide and bromine, discovered some time ago by M. Schützenberger.

Diethylic Ether of Xantho-Acetic Acid.—M. C. O. Cech and A. Steiner.—This compound, resulting from the action of ethyl-mono-chlor-acetate upon potassium xanthate is a yellowish oily liquid, heavier than water, and of a disagreeable odour. When distilled under ordinary atmospheric pressure it is decomposed, but it may be distilled in a vacuum. Its composition is $C_7H_{12}O_3S_2$.

Determination of Sulphide of Carbon in the Sulpho-Carbonates of Potash and Soda.—MM. David and Rommier.—Not adapted for abstraction.

No. 4, July 26, 1875.

Distribution of Magnetism in Bundles Composed of Very Thin Plates of a Finite Length.—M. J. Jamin.—This paper consists chiefly of tables and mathematical formulæ, and cannot be usefully abstracted.

Complementary Notice on the Contemporaneous Formation of Minerals by the Thermal Springs of Bourbonne-les-Bains (Haute Marne); Production of Phosgenite.—M. Daubrée.—Phosgenite, which has been met with in large crystals at Crawford, near Matlock in Derbyshire (?), in Scotland, Upper Silesia, and in Sardinia, is a rare species. Here it is produced in abundance. It is coated over with a thin layer of galena, resulting from its decomposition under the combined reducing action of organic matter and of gypsum.

Researches on the Phenomena Produced by Electric Currents of High Potential, and on their Analogies with Natural Phenomena.—M. G. Planté.—Having employed as voltameter a U-tube full of salt water, and submitted it to the action of the electric source indicated in a former communication, the author observed the following phenomena. If, the negative wire being plunged in one of the limbs of the tube, the end of the positive wire is placed in contact with the glass in the other limb, a little above the liquid, we perceive at first around the wire a glittering crown produced by the saline particles which line the tube. If the wire is approached towards the liquid a depression is produced; a luminous arch, bordered with radiating striæ, appears along the glass, aud is transformed into an irregular demi-crown with sinuous outline, and animated with a rapid undulatory movement. Steam escapes in rapid jets above the sparks of fire, as if it issued from a boiler under pressure. The concavity of the luminous arch in the voltameter, turned towards the point whence the positive current issues, compared to the concavity of the aurora turned towards the earth, shows that the flow of the electric currents, brought from the equator by the higher winds is from below upwards, that is, from these regions of the atmosphere to still loftier ones. These currents, impinging upon the icy clouds of the poles, which correspond to the saline particles and to the moist glass of the voltameter, are transformed into heat and light, and vapourise the polar clouds which are re-precipitated in the form of snow or rain. Thus the polar aurora is due, not to discharges between the electricity of the atmosphere and that of the ground—which would involve the poles in a perpetual thunderstorm—but rather to the dissemination in the higher atmosphere of the great masses of electricity derived from the surface of the globe in a calorific and luminous form. Finally, if it is permissible to carry out the analogies further, we find in the phenomena observed a reproduction on an infinitely small scale of the possible mode of formation of the heavenly bodies, spherical or annular, and a rapid image of their development down to their extinction or transformation in space. We are thus led to think that in the first impulse given, or in the number of the various movements impressed upon the ethereal matter in the work of creation, it is necessary to include that particular mode of motion which constitutes electricity, masked as it might be under the more striking phenomena of heat and light.

Action of Electrolytic Oxygen upon Glycerin.—M. A. Renard.—Glycerin, mixed with two-thirds its volume of water, acidulated with a twentieth of sulphuric acid, and submitted to the action of electrolytic oxygen, yielded various oxidation products, among which formic and acetic acids have been detected in great quantity; glyceric acid; the first glyceric aldehyd: and a product which may be the acid corresponding to the second glyceric aldehyd.

Pyrites Used in France in the Manufacture of Sulphuric Acid.—MM. A. Girard and H. Morin.—The consumption of pyrites in France has risen during the last ten years from an annual amount of 90,000 tons to 180,000 tons. In England, during the same period, it has risen from 180,000 to 520,000. The pyrites of the Rhone, or of Saint Bel, contain on an average 46 to 48 per cent of sulphur, with 10 to 12 per cent of a gangue of clay, sand, and heavy spar. In the southern portion of the Saint Bel district the sulphur ranges ftom 50 to 53 per cent. The gangue is slight, and free from baryta. Arsenic is found only in proportions too small to be determined. In the Saint Julien district (le Gard) the pyrites are found not in argillaceous schists, as at Saint Bel, but in the lias or trias. The sulphur varies from 40 to 45 per cent. The gangue is calcareous, and ranges from 3 to 6 per cent. Arsenic is found to the extent of one-tenth per cent, and the amount of calcium fluoride is sometimes determinable. The pyrites of Ardèche contain 45 to 50 per cent of sulphur; the gangue is argillaceous, free from lime. In some samples the arsenic reaches three-tenths per cent. The total amount of pyrites in France is equal to a century's consumption.

Toxic Properties of Alcohols.—The poisonous properties of the fermentation alcohols follow their atomic composition in mathematical order. The higher the figures representing the latter the more deadly is their action, whether injected under the skin or introduced into the stomach.

Thermic Phenomenon which Accompanies "Inversion."—M. G. Fleury.—The author concludes that the inversion of sugar is an exothermic phenomenon, and results necessarily whenever an acid of sufficient power is present.

Substance Used to Adulterate Guano.—M. F. Jean.—For some years there have arrived at Dunkirk large quantities of a pulverulent matter, of a yellowish brown colour, the sole consumption of which is in the sophistication of guano. The amount landed at Dunkirk is more than a million kilos. yearly. The article is especially made in England on the large scale. In colour and specific gravity it agrees closely with genuine guano. It is inodorous, neutral, tasteless, leaves a white ash on ignition, and may be mixed with guano in a considerable proportion without modifying its appearance. It consists of—

Moisture	16·80
Sulphate of lime	63·50
Phosphate of lime, with traces of ferric oxide and alumina	12·06
Silica	0·50
Carbonate of lime	1·60
Chloride of sodium	3·71
Nitrogenous matter (containing 0·3 per cent of nitrogen)	1·80
	99·97

The nitrogenous matter which gives the colour of guano to this mixture is probably obtained by submitting woollen rags to steam at a high pressure.

Moniteur Scientifique, du Dr. Quesneville, August, 1875.

Observations on Sea-Salts.—Dr. Roux.—A very lengthy treatise on the salts obtained by evaporating sea-water. It is quite incapable of useful abstraction.

Antiseptic Properties of Salicylic and Phenic Acids.—Julius Müller.—Salicylic acid energetically prevents fermentation and putrefaction, and neutralises the effects of inorganic ferments much more strongly than even phenol. This may be explained by the circumstance that salicylic acid acts as much by its acidity as by its anti-fermentescible attributes. Phenol has no acid reaction.

Preparation of Very Concentrated Formic Acid.—M. Lorin.—Already noticed.

Manufacture of Beer.—Aime Girard.—Not suitable for abstraction.

Procedures for the Cure of the Vine.—M. M. Morel.—A summary of the various methods proposed for the destruction of the phylloxera.

Limited Oxidation of the Carbides of Hydrogen.—M. Berthelot.—Taken from the *Bulletin de la Société Chimique de Paris*, xxiii., p. 197.

Use of Arsenic in the Production of Aniline Colours.—The firm of Meister, Lucius, aud Brüning write to state that since the end of 1872 no arsenic has been employed in their establishment, and that they guarantee all their dyes to be free from that dangerous substance.

MISCELLANEOUS.

University of London.—The following are lists of the candidates who have passed the recent B.Sc. and Preliminary Scientific Examinations:—*First B.Sc. Examination.* (First Division). F. Baylis, Epsom College; J. H. Best, University College; R. Bredin, Liverpool Royal Infirmary School of Medicine and private study; H. A. G. Brooke, B.A., Owens College; G. Brown, Owens College; R. H. Bulley, Owens College; J. E. Clark, B.A., Heidelberg University; C. Dalgarno, private study; A. C. Dixon, private study; J. V. Elsden, private study; J. W. Evans, University College; G. C. Frames, Royal School of Mines; G. A. Freeman, St. John's College, Battersea, and private study; F. J. Gladman, B.A., private study; C. R. Harrison, University College; H. Heap, St. Mark's College, Chelsea, and private study; W. Hewitt, Royal School of Mines; G. B. Hughes, Wesleyan College, Taunton; T. S. Humpidge, Royal School of Mines; A. H. Jackson, Owens College; W. W. Jones, Magdalen College, Oxford; A. P. Ledward, Owens College; A. H. S. Lucas, New Kingswood School; A. McAlpine, Royal College of Science, Dublin; J. L. McKenzie, private study; J. Mortimer, B.A., University College, London, and University College, Edinburgh; W. J. Noble, Keble College, Oxford; J. O. Park, private study; L. C. Parkes, University College; W. Pearce, St. Mary's Hospital; J. J. Quelch, New College, Eastbourne; D. Robertson, LL.B., private study; D. Ross, B.A., private study; R. H. S. Spicer, private study; W. J. Spratling, private study and Royal School of Chemistry; E. H. Sugden, B.A., Owens and Headingley Colleges; S. P. Thompson, B.A., private study; A. E. Tovey, private study; G. W. von Tunzelmann, University College; E. H. Wainwright, University College; R. Whitby, B.A., private study; A. R. Willis, Royal School of Mines. (Second Division). D. E. Anderson, B.A., Royal College, Mauritius, and University College; G. H. Bailey, private study; J. Enright, private study; W. Fawcett, private study; J. A. Miller, B.A., private study; W. Outhwaite, private study; C. J. Procter, Owens College; J Spencer, private study; J. H. Stewart, Royal College of Science and private study; W. C. Trafford, University College. *Preliminary Scientific (M.B.) Examination.* (First Division). F. R. Barker, St. Thomas's Hospital; F. Baylis, Epsom College; J. H. Best, University College; R. Bredin, Royal Infirmary School, Liverpool, and private study; H. A. G. Brooke, B.A., Owens College; G. Brown, Owens College; L. A. Cantin, St. Bartholomew's Hospital; W. G. Chuckerbutty, University College; C. A. D. Clark, St. Bartholomew's Hospital; T. F. Clarke, King's College; W. W. Colborne, University College; M. P. M. Collier, St. Thomas's Hospital; T. Crisp, St. Thomas's Hospital; E. M. Cuffe, Epsom College; C. W. Cunnington, private study; D. S. Davies, St. Thomas's Hospital; A. Dismorr, St. Bartholomew's Hospital; A. C. Dixon, private study; W. W. Edwardes, St. Mary's Hospital; J. V. Elsden, private study; J. T. Faulkner, Manchester Medical School; H. A. H. Fenton, University College; T. W. Fuller, Guy's Hospital; A. W. Graham, St. Bartholomew's Hospital; M. Greenwood, London Hospital; A. J. Harries, University College; C. R. Harrison, University College; A. Harvey, Queen's College, Birmingham; T. H. Hayle, Owens College; G. A. Herschell, St. Thomas's Hospital; W. Hewitt, Royal School of Mines; J. E. Hine, University College; W. B. Hinton, Guy's Hospital; J. Hodgson, Owens College Medical School; V. A. H. Horsley, University College; T. Hoskin, University College; R. Hughes, private study; T. S. Humpidge, Royal School of Mines; W. W. Jones, Magdalen College, Oxford; A. P. Ledward, Owens College; M. Lichtenstein, private study; W. M. Lory, University College; A. McAlpine, Royal College of Science, Dublin; G. M. McDonald, King's College; A. Meeson, Royal Infirmary, Liverpool; H. J. Michael, St. Thomas's Hospital; F. W. Mott, University College; H. M. Murray, Camden Schools, Brighton, and Sussex College Hospital; J. H. Nankivell, King's College; W. H. Neale, private study; W. J. Noble, Keble College, Oxford; W. J. C. Nourse, St. Mary's Hospital; A. M. Palmer, University College; W. Pasteur, University College; W. Pearce, St. Mary's Hospital; E. Penny, Guy's Hospital; L. C. Ponsford, University College; T. W. O. Pughe, Royal Infimary, Liverpool; J. J. Quelch, New College, Eastbourne; N. K. Ráy, University of Edinburgh; F. Robinson, Leeds School of Medicine; D. Ross, B.A., private study; F. Rushworth, St. Bartholomew's Hospital; G. H. Russell, Guy's Hospital; T. D. Savill, St. Thomas's Hospital; P. E. Shearman, University College; T. S. Sheldon, Guy's Hospital; J. F. W. Silk, King's College; E. S. Smith, University College; R. P. Smith, St. Thomas's Hospital; J. E. Squire, University College; C. W. Suckling, private study; A. M. Turner, Guy's Hospital; E. H. Wainwright, University College; W. H. White, Guy's Hospital; A. R. Willis, Royal School of Mines; L. C. Wooldridge, Guy's Hospital. (Second Division.) D. G. Allen, St. George's Hospital; W. E. Barton, University College; H. T. Bassett, Queen's College, Birmingham; A. Chillingworth, St. Bartholomew's Hospital; W. L. Cranstone, University College; A. D. Deane, Guy's Hospital; G. J. Eady, private study; J. Enright, private study; T. Finlay, University College; R. Hagyard, Leeds School of Medicine; J. D. Hayward, University, Bonn, and private study; H. Hine, Guy's Hospital; C. P. Hooker, St. Bartholomew's Hospital; G. Hurst, B.A., Sydney, University of Edinburgh; C. M. H. Jones, St. Mary's Hospital; P. S. Kendall, University College; A. Money, University College; E. Nettleford, University College; W. Outhwaite, private study; E. M. Price, University College; A. C. Rich, Royal Infirmary, Liverpool; A. J. McC. Routh, University College; E. F. Smith, St. George's Hospital; H. Swale, University College; R. D. R. Sweeting, London Hospital; G. F. Symons, Guy's Hospital; E. S. Taite, St. Bartholomew's Hospital; W. D. Thomas, Epsom College; W. P. R. Williams, St. George's Hospital; H. W. Yate; Epsom College.

NOTES AND QUERIES.

Gas-Water.—Would any reader oblige by particulars how to test the ammonia in ounce's strength, and state where I can buy the necessary apparatus for same?—CARBON.

Crude Carbonate of Ammonia.—Can any of the readers of the CHEMICAL NEWS inform me if crude carbonate of ammonia containing 26 per cent of NH_3 is readily saleable in large quantity, and if so, what is it used for and how much is it worth per ton?—W.

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THE CHEMICAL NEWS.

Vol. XXXII. No. 822.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Bristol Meeting, August 25, 1875.

INAUGURAL ADDRESS OF THE PRESIDENT,

Sir John Hawkshaw, F.R.S.

Gentlemen,—To those on whom the British Association confers the honour of presiding over its meetings, the choice of a subject presents some difficulty.

The Presidents of Sections, at each annual meeting, give an account of what is new in their respective departments; and essays on science in general, though desirable and interesting in the earlier years of the Association, would be less appropriate to-day.

Past Presidents have already discoursed on many subjects, on things organic and inorganic, on the mind and on things perhaps beyond the reach of mind; and I have arrived at the conclusion that humbler themes will not be out of place on this occasion.

I propose in this Address to say something of a profession to which my lifetime has been devoted—a theme which cannot perhaps be expected to stand as high in your estimation as in my own, and I may have some difficulty in making it interesting; but I have chosen it because it is a subject I ought to understand better than any other. I propose to say something on its origin, its work, and kindred topics.

Rapid as has been the growth of knowledge and skill as applied to the art of the engineer during the last century, we must, if we would trace its origin, seek far back among the earliest evidences of civilisation.

In early times, when settled communities were few and isolated, the opportunities for the interchange of knowledge were scanty or wanting altogether. Often the slowly accumulated results of the experience of the wisest heads and the most skilful hands of a community were lost on its downfall. Inventions of one period were lost and found again. Many a patient investigator has puzzled his brain in trying to solve a problem which had yielded to a more fortunate labourer in the same field some centuries before.

The ancient Egyptians had a knowledge of Metallurgy, much of which was lost during the years of decline which followed the golden age of their civilisation. The art of casting bronze over iron was known to the Assyrians, though it has only lately been introduced into modern metallurgy; and patents were granted in 1609 for processes connected with the manufacture of glass, which had been practised centuries before.* An inventor in the reign of Tiberius devised a method of producing flexible glass, but the manufactory of the artist was totally destroyed, we are told, in order to prevent the manufacture of copper, silver, and gold from becoming depreciated.†

Again and again engineers, as well as others, have made mistakes from not knowing what those had done who have gone before them, and have had the same difficulties to contend with. In the long discussion which took place as to the practicability of making the Suez Canal, an early objection was brought against it that there was a difference of 32½ feet between the level of the Red Sea and that of the Mediterranean. Laplace at once declared that such could not be the case, for the mean level of the sea was the same on all parts of the globe. Centuries before the time of Laplace the same objection had been raised against a project for joining the waters of these two seas. According to the old Greek and Roman historians, it was a fear of flooding Egypt with the waters of the Red Sea that made Darius, and in later times, again, Ptolemy, hesitate to open the canal between Suez and the Nile.* Yet this canal was made, and was in use some centuries before the time of Darius.

Strabo† tells us that the same objection—that the adjoining seas were of different levels—was made by his engineers to Demetrius,‡ who wished to cut a canal through the Isthmus of Corinth some two thousand years ago. But Strabo|| dismisses at once this idea of a diffetence of level, agreeing with Archimedes that the force of gravity spreads the sea equally over the earth.

When knowledge in its higher branches was confined to a few, those who possessed it were often called upon to perform many and various services for the communities to which they belonged; and we find mathematicians and astronomers, painters and sculptors, and priests, called upon to perform the duties which now pertain to the profession of the architect and the engineer. And as soon as civilisation had advanced so far as to admit of the accumulation of wealth and power, then kings and rulers sought to add to their glory while living by the erection of magnificent dwelling-places, and to provide for their aggrandisement after death by the construction of costly tombs and temples. Accordingly, we soon find men of ability and learning devoting a great part of their time to building and architecture, and the post of architect became one of honour and profit. In one of the most ancient quarries of Egypt a royal high architect of the dynasty of the Psammetici has left his pedigree sculptured on the rock, extending back for twenty-three generations, all of whom held the same post in succession in connection with considerable sacerdotal offices.§

As there were in these remote times officers whose duty it was to design and construct, so also there were those whose duty it was to maintain and repair the royal palaces and temples. In Assyria, 700 years before our era, as we know from a tablet found in the palace of Sennacherib by Mr. Smith, there was an officer whose title was the Master of Works. The tablet I allude to is inscribed with a petition to the king from an officer in charge of a palace, requesting that the Master of Works may be sent to attend to some repairs which were much needed at the time.¶

Under the Roman Empire there was almost as great a division of labour in connection with building and design as now exists. The great works of that period were executed and maintained by an army of officers and workmen, who had special duties assigned to each of them.

Passing by those early attempts at design and construction which supplied the mere wants of the individual and the household, it is to the East that we must turn if we would find the earliest works which display a knowledge of engineering. Whether the knowledge of engineering, if we may so call it, possessed by the people of Chaldæa and Babylonia was of native growth or was borrowed from Egypt is, perhaps, a question which cannot yet be answered. Both people were agricultural, dwelling on fertile plains, intersected by great rivers, with a soil requiring water only to enable it to bring forth inexhaustible crops. Similar circumstances would create similar wants, and stimulate to action similar faculties to satisfy them. Apart from the question of priority of knowledge, we know that at a very early period—some four or five thousand years

* Layard's "Nineveh and Babylon," p. 191; Beckman's "History of Inventions," vol. ii., p. 85.

† Pliny, "Nat. Hist.," Bk. xxxvi., c. 66,

* Pliny, "Nat. Hist.," Bk. vi., c. 33.

† Strabo, c. iii., § 11.

‡ Demetrius I., King of Macedonia, died 283 B.C.

|| Strabo, c. iii., Sec. 12.

§ "Discoveries in Egypt, Ethiopia, &c.," by Dr. Lepsius, 2nd edr., p. 318.

¶ Smith's (G.) 'Assyrian Discoveries," 2nd edit., p. 414.

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ago at least—there were men in Mesopotamia and Egypt who possessed considerable mechanical knowledge, and no little skill in hydraulic engineering. Of the men themselves we know little: happily, works often remain when the names of those who conceived and executed them have long been forgotten.

It has been said that architecture had its origin not only in nature, but in religion; and if we regard the earliest works which required mechanical knowledge and skill, the same may be said of engineering. The largest stones were chosen for sacred buildings, that they might be more enduring as well as more imposing, thereby calling for improvement and invention of mechanical contrivances, to assist in transporting and elevating them to the position they were to occupy; for the same reason the hardest and most costly materials were chosen, calling for further improvement in the metal forming the tools required to work them. The working of metals was further perfected in making images of the gods, and in adorning with the more precious and ornamental sorts the interior and even external parts of their shrines.

The earliest buildings of stone to which we can assign a date, with any approach to accuracy, are the pyramids of Gizeh. To their builders they were sacred buildings, even more sacred than their temples or temple palaces. They were built to preserve the royal remains, until, after a lapse of 3000 years, which we have reason to believe was the period assigned, the spirit which had once animated the body should re-enter it.* Although built 5000 years ago, the masonry of the Pyramids could not be surpassed in these days; all those who have seen and examined them, as I myself have done, agree in this: moreover, the design is perfect for the purpose for which they were intended, above all to endure. The building of pyramids in Egypt continued for some ten centuries, and from sixty to seventy still remain, but none are so admirably constructed as those of Gizeh. Still, many contain enormous blocks of granite from 30 to 40 feet long, weighing more than 300 tons, and display the greatest ingenuity in the way in which the sepulchral chambers are constructed and concealed.†

The genius for dealing with large masses in building did not pass away with the pyramid builders in Egypt, but their descendants continued to gain in mechanical knowledge, judging from the enormous blocks which they handled with precision. When the command of human labour was unlimited, the mere transport of such blocks as the statue of Rameses the Great, for instance, which weighed over 800 tons, need not so greatly excite our wonder; and we know how such blocks were moved from place to place, for it is shown on the wall paintings of tombs of the period which still remain.

But as the weight of the mass to be moved is increased, it becomes no longer a question of only providing force in the shape of human bone and muscle. In moving, in the last century, the block which now forms the base for the statue of Peter the Great, at St. Petersburg, and which weighs 1200 tons, force could be applied as much as was wanted, but great difficulty was experienced in supporting it, and the iron balls on which it was proposed to roll the block along were crushed, and a harder metal had to be substituted.‖ To facilitate the transport of material, the Egyptians made solid causeways of granite from the Nile to the Pyramids; and in the opinion of Herodotus, who saw them, the causeways were more wonderful works than the Pyramids themselves.§

The Egyptians have left no record of how they accomplished a far more difficult operation than the mere transport of weight—that is, how they erected obelisks weighing more than 400 tons. Some of these obelisks must have been lifted vertically to place them in position, as they were by Fontana in Rome in later times, when the knowledge of mechanics, we know, was far advanced.*

The practice of using large blocks of stone, either as monoliths or as forming parts of structures, has existed from the earliest times in all parts of the world.

The Peruvians used blocks weighing from 15 to 20 tons, and fitted them with the greatest nicety in their cleverly designed fortifications.†

In India, large blocks were used in bridges when the repugnance of Indian builders to the use of the arch rendered them necessary, or in temples where—as in the Temple of the Sun at Orissa—stones weighing from 20 to 30 tons form part of the pyramidal roof at a height of from 70 to 80 feet from the ground.‡ Even as late as the last century, Indians, without the aid of machinery, were using blocks of granite above 40 feet long for the doorposts of the gateway of Seringham, and roofing blocks of the same stone for a span of 21 feet.‖

At Persepolis, in the striking remains of the palaces of Xerxes and Darius, more than one traveller has noted the great size of the stones, some of which are stated to be 55 feet long and 6 to 10 feet broad.

So in the Greek temples of Sicily, many of the blocks in the upper parts of the temples are from 10 to 20 tons weight.

The Romans, though they did not commonly use such large stones in their own constructions, carried off the largest obelisks from Egypt and erected them at Rome, where more are now to be found than remain in Egypt. In the temples of Baalbek, erected under Roman rule, perhaps the largest stones are to be found which have been used for building since the time of the Pharaohs. The terrace wall of one of the temples is composed of three courses of stones, none of which are less than 30 feet long; and one stone still lies in the quarry squared and ready for transport, which is 70 feet long and 14 feet square, and weighs upwards of 1135 tons, or nearly as much as one of the tubes of the Britannia Bridge.

I have not mentioned dolmens and menhirs, rude unhewn stones often weighing from 30 to 40 tons, which are found from Ireland to India, and from Scandinavia to the Atlas, in Africa. To transport and erect such rude masses required little mechanical knowledge or skill, and the operation has excited more wonder than it deserves. Moreover, Fergusson has gone far to show that the date assigned to many of them hitherto has been far too remote; most, and possibly all, of those in northern and western Europe having been erected since the time of the Roman occupation. And to this day the same author shows that menhirs, single stones often weighing over 20 tons, are erected by hill tribes of India in close proximity to stone buildings of elaborate design and finished execution, erected by another race of men.§

For whatever purpose these vast stones were selected—whether to enhance the value or to prolong the endurance of the buildings of which they formed a part—the tax on the ingenuity of those who moved and placed them must have tended to advance the knowledge of mechanical appliances.

The ancient Assyrians and Egyptians had possibly more knowledge of mechanical appliances than they are generally credited with. In the wall paintings and sculptures which show their mode of transporting large blocks of stone, the lever is the only mechanical power represented, and which they appear to have used in such operations; nor ought we to expect to find any other used, for, where the supply of human labour was unlimited, the most expeditious mode of dragging a heavy weight along would

* Fergusson's "History of Architecture," vol. i., p. 83; Wilkinson's "Ancient Egyptians," 2nd series, vol. ii., p. 444.
† Vyse's "Pyramids of Gizeh," vol. iii., pp. 16, 41, 45, 57.
‡ Rondelet's "Traité de l'Art de Bâtir," vol. i., p. 73.
§ Herodotus, Bk. ii. c. 124.

* For obelisk erected at Arles, 1676 see Rondelet's "L'Art de Bâtir," vol. i., p. 48. Its weight was nearly 200 tons, and it was suspended vertically by eight ships' masts.
† Fergusson's "History of Architecture," vol. ii., p. 779; Squier, "Peru," p. 24.
‡ The Temple of the Sun was built 1237—1282 A.D.—Hunter's "Orissa," vol. i., pp. 288, 297.
‖ Fergusson's "Rude Stone Monuments," p. 96.
§ Fergusson's "Rude Stone Monuments," pp. 461—465

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be by human power; to have applied pulleys and capstans, such as would now be employed in similar undertakings, would have been mere waste of time. In some countries, even now, where manual labour is more plentiful than mechanical appliances, large numbers of men are employed to transport heavy weights, and do the work in less time than it could be done with all our modern mechanical appliances. In other operations, such as raising obelisks, or the large stones used in their temple palaces, where human labour could not be applied to such advantage, it is quite possible that the Egyptians used mechanical aids. On one of the carved slabs which formed part of the wall panelling of the palace of Sardanapalus, which was built about 930 years before our era, a single pulley is clearly shown, by which a man is in the act of raising a bucket—probably drawing water from a well.*

It has sometimes been questioned whether the Egyptians had a knowledge of steel. It seems unreasonable to deny them this knowledge. Iron was known at the earliest times of which we have any record. It is often mentioned in the Bible, and in Homer; it is shown in the early paintings on the walls of the tombs at Thebes, where butchers are represented as sharpening their knives on pieces of metal coloured blue, which were most probably pieces of steel.† Iron has been found in quantity in the ruined palaces of Assyria; and in the inscriptions of that country fetters are spoken of as having been made of iron, which is also so mentioned in connection with other metals as to lead to the supposition that it was regarded as a base and common metal. Moreover, in the Great Pyramid a piece of iron was found in a place where it must have lain for 5000 years.‡ The tendency of iron to oxidise must render its preservation for any long period rare and exceptional. The quality of iron which is now made by the native races of Africa and India is that which is known as wrought iron: in ancient times, Dr. Percy says the iron which was made was always wrought iron. It is very nearly pure iron, and a very small addition of carbon would convert it into steel. Dr. Percy says the extraction of good malleable iron directly from the ore "requires a degree of skill very far inferior to that which is implied in the manufacture of bronze." ‖ And there is no great secret in making steel: the natives of India now make excellent steel in the most primitive way, which they have practised from time immemorial. When steel is to be made, the proportion of charcoal used with a given quantity of ore is somewhat larger, and the blast is applied more slowly than when wrought iron is the metal required.§ Thus, a vigorous native working the bellows of skin would make wrought iron where a lazy one would have made steel. The only apparatus required for the manufacture of the finest steel from iron ore is some clay for making a small furnace 4 feet high, and from 1 to 2 feet broad, some charcoal for fuel, and a skin with a bamboo tuyere for creating the blast.

The supply of iron in India as early as the fourth and fifth centuries seems to have been unlimited. The iron pillar of Delhi is a remarkable work for such an early period. It is a single piece of wrought iron 50 ft. in length, and it weighs not less than 17 tons.¶ How the Indians forged this large mass of iron and other heavy pieces which their distrust of the arch led them to use in the construction of roofs, we do not know. In the temples of Orissa iron was used in large masses as beams or girders in roof-work in the thirteenth century.**

The influence of the discovery of iron on the progress of art and science cannot be over-estimated. India well repaid any advantage which she may have derived from the early civilised communities of the West if she were the first to supply them with iron and steel.

An interesting social problem is afforded by a comparison of the relative conditions of India and this country at the present time. India, from thirty to forty centuries ago, was skilled in the manufacture of iron and cotton goods, which manufactures, in less than a century, have done so much for this country. It is true that in India coal is not so abundant or so universally distributed as in this country. Yet, if we look still further to the East, China had probably knowledge of the use of metals as soon as India, and moreover had a boundless store of iron and coal. Baron Richthofen, who has visited and described some of the coalfields of China, believes that one province alone, that of Southern Shansi, could supply the world at its present rate of consumption for several thousand years. The coal is near the surface, and iron abounds with it. Marco Polo tells us that coal was universally used as fuel in the parts of China which he visited towards the end of the fourteenth century, and from other sources we have reason to believe it was used there as fuel 2000 years ago. But what progress has China made in the last ten centuries? A great future is undoubtedly in store for that country; but can the race who now dwell there develop its resources, or must they await the aid of an Aryan race? Or is anything more necessary than a change of institutions, which might come unexpectedly, as in Japan?

The art of extracting metals from the ore was practised at a very early date in this country. The existence long ago of tin mines in Cornwall, which are so often spoken of by classical writers, is well known to all. That iron was also extracted from the ore by the ancient Britons is most probable, as it was largely used for many purposes by them before the Roman conquest. The Romans worked iron extensively in the Weald of Kent, as we assume from the large heaps of slag containing Roman coins which still remain there. The Romans always availed themselves of the mineral wealth of the countries which they conquered, and their mining operations were often carried out on the largest scale, as in Spain, for instance, where as many as forty thousand miners were regularly employed in the mines at New Carthage.*

Coal, which was used for ordinary purposes in England as early as the ninth century, does not appear to have been largely used for iron smelting until the eighteenth century, though a patent was granted for smelting iron with coal in the year 1611.† The use of charcoal for that purpose was not given up until the beginning of this century, since which period an enormous increase in the mining and metallurgical industries has taken place; the quantity of coal raised in the United Kingdom in 1873 having amounted to 127 million tons, and the quantity of pig iron to upwards of 6½ million tons.

The early building energy of the world was chiefly spent on the erection of tombs, temples, and palaces.

While, in Egypt, as we have seen, the art of building in stone had 5000 years ago reached the greatest perfection, so in Mesopotamia the art of building with brick, the only available material in that country, was in an equally advanced state some ten centuries later. That buildings of such a material have lasted to this day shows how well the work was done; their ruinous condition even now is owing to their having served as quarries for the last three or four thousand years, so that the name of Nebuchadnezzar, apparently one of the greatest builders of ancient times, is as common on the bricks of many modern towns in Persia as it was in old times in Babylon. The labour required to construct the brick temples and palaces of Chaldæa and Assyria must have been enormous. The mound of Koyunjik alone contained 14½ million tons, and represents the labour of 10,000 men for twelve years. The palace of Sennacherib, which stood on this mound, was probably the largest ever built by any one monarch,

* Layard's "Nineveh and its Remains," vol. ii., p. 31.
† Wilkinson's "Ancient Egyptians," vol. iii., p. 247.
‡ Vyse's "Pyramids of Gizeh," vol. i., p. 275.
‖ Percy's "Iron and Steel," p. 873.
§ *Ibid.*, p. 259.
¶ Fergusson's "History of Architecture," vol. ii., p. 460; and "Rude Stone Monuments," pp. 481-3. Cunningham's "Archæological Survey of India," vol. i., p. 169.
** Hunter's "Orissa," vol. i., p. 298,

* Strabo, Bk. iii., c. ii., sec. 10.
† Percy's "Iron and Steel," p. 882.

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containing as it did more than two miles of walls, panelled with sculptured alabaster slabs, and twenty-seven portals, formed by colossal bulls and sphinxes.*

The pyramidal temples of Chaldæa are not less remarkable for the labour bestowed on them, and far surpass the buildings of Assyria in the excellence of their brickwork.

The practice of building great pyramidal temples seems to have passed eastwards to India and Burmah, where it appears in buildings of a later date, in Buddhist topes and pagodas; marvels of skill in masonry, and far surpassing the old brick moulds of Chaldæa in richness of design and in workmanship. Even so late as this century a king of Burmah began to build a brick temple of the old type, the largest building, according to Fergusson, which has been attempted since the Pyramids.†

The mere magnitude of many of these works is not so wonderful when we take into account the abundance of labour which those rulers could command. Countries were depopulated, and their inhabitants carried off and made to labour for the conquerors. The inscriptions of Assyria describe minutely the spoils of war and the number of captives; and in Egypt we have frequent mention made of works being executed by the labour of captive peoples. Herodotus tells us that as many as 360,000 men were employed in building one palace for Sennacherib.‡ At the same time, it must not be forgotten that the very character of the multitude would demand from some one the skill and brain to organise and direct, to design and plan the work.

It would be surprising if men who were capable of undertaking and successfully completing unproductive works of such magnitude did not also employ their powers on works of a more useful class. Traces still remain of such works; enough to show, when compared with the scanty records of the times which have come down to us, that the prosperity of such countries as Egypt and Mesopotamia was not wholly dependent on war and conquest, but that the reverse was more likely the case, and that the natural capabilities of those countries were greatly enlarged by the construction of useful works of such magnitude as to equal, if not in some cases surpass, those of modern times.

Egypt was probably far better irrigated in the days of the Pharaohs than it is now. To those unacquainted with the difficulties which must be met with and overcome before a successful system of irrigation can be carried out, even in countries in which the physical conditions are favourable, it may appear that nothing more is required than an adequate supply of unskilled labour. Far more than this was required: the Egyptians had some knowledge of surveying, for Eustathius says they recorded their marches on maps;|| but such knowledge was probably in those days very limited, and it required no ordinary grasp of mind to see the utility of such extensive works as were carried out in Egypt and Mesopotamia, and, having seen the utility, to successfully design and execute them. To cite one in Egypt—Lake Mœris, of which the remains have been explored by M. Linant, was a reservoir made by one of the Pharaohs, and supplied by the flood waters of the Nile. It was 150 square miles in extent, and was retained by a bank or dam 60 yards wide and 10 high, which can be traced for a distance of thirteen miles. This reservoir was capable of irrigating 1200 square miles of country.§ No work of this class has been undertaken on so vast a scale since, even in these days of great works.

The prosperity of Egypt was in so great a measure dependent on its great river, that we should expect that the Egyptians, a people so advanced in art and science, would at an early period have made themselves acquainted with its *regimé*. We know that they carefully registered the height of the annual rise of its waters; such registers still remain inscribed on the rocks on the banks of the Nile, with the name of the king in whose reign they were made.* The people of Mesopotamia were equally observant of the *regimé* of their great rivers, and took advantage in designing their canals of the different periods of the rising of the waters of the Tigris and Euphrates. A special officer was appointed in Babylon, whose duty it was to measure the rise of the river; and he is mentioned in an inscription found in the ruins of that city, as recording the height of the water in the temple of Bel.† The Assyrians, who had a far more difficult country to deal with, owing to its rocky and uneven surface, showed even greater skill than the Babylonians in forming their canals, tunnelling through rock, and building dams of masonry across the Euphrates. While the greater number of these canals in Egypt and Mesopotamia were made for the purpose of irrigation, others seem to have been made to serve at the same time for navigation. Such was the canal which effected a junction between the Mediterranean and the Red Sea, which was a remarkable work, having regard to the requirements of the age in which it was made. Its length was about 80 miles; its width admitted of two triremes passing one another.‡ At least one of the navigable canals of Babylonia, attributed to Nebuchadnezzar, can compare in extent with any work of later times. I believe Sir H. Rawlinson has traced the canal to which I allude throughout the greater part of its course, from Hit on the Euphrates to the Persian Gulf, a distance of between four and five hundred miles.|| It is a proof of the estimation in which such works were held in Babylonia and Assyria, that, among the titles of the god Vul were those of "Lord of Canals," and "The Establisher of Irrigation Works."§

The springs of knowledge which had flowed so long in Babylonia and Assyria were dried up at an early period. With the fall of Babylon and destruction of Nineveh the settled population of the fertile plains around them disappeared, and that which was desert before man led the waters over it became desert again, affording a wide field for, and one well worthy of, the labours of engineers to come.

Such was not the case with Egypt. Long after the period of its greatest prosperity was reached, it remained the fountain head from whence knowledge flowed to Greece and Rome. The philosophers of Greece and those who, like Archimedes, were possessed of the best mechanical knowledge of the time, repaired to Egypt to study and obtain the foundation of their knowledge from thence.

Much as Greece and Rome were indebted to Egypt, it will probably be found, as the inscribed tablets met with in the mounds of Assyria and Chaldæa are deciphered, that the later civilisations owe, if not more, at least as much, to those countries as to Egypt. This is the opinion of Mr. Smith, who, in his work describing his recent interesting discoveries in the East, says that the classical nations "borrowed far more from the valley of the Euphrates than that of the Nile."¶

In the science of astronomy, which in these days is making such marvellous discoveries, Chaldæa was undoubtedly pre-eminent. Among the many relics of these ancient peoples which Mr. Smith has recently brought to this country is a portion of a metal astrolabe from the palace of Sennacherib, and a tablet on which is recorded the division of the heavens according to the four seasons, and the rule for regulating the intercalary month of the year. Not only did the Chaldeans map out the heavens

* Layard's "Nineveh and Babylon," p. 589.
† Fergusson's "History of Architecture," vol. ii., p. 523.
‡ Rawlinson's "Herodotus," vol. i., p. 389, second edition.
|| Rawlinson's "Herodotus," vol. ii., p. 278, second edition.
§ M. Linant's "Mémoire sur le lac Mœris.

* Lepsius's "Discoveries in Egypt," &c., p. 268.
† Smith's "Assyrian Discoveries," pp. 395-7, second edition.
‡ "Herodotus," Bk. ii., c. clviii.
|| Rawlinson's "Herodotus," vol. i., p. 420, second edition.
§ *Ibid.*, p. 498.
¶ Smith's (G.) "Assyrian Discoveries," p. 451, second edition.

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and arrange the stars, but they traced the motion of the planets, and observed the appearance of comets; they fixed the signs of the zodiac, and they studied the sun and moon and the periods of eclipses.*

But to return to that branch of knowledge to which I wish more particularly to draw your attention, as it grew and spread from East to West, from Asia over Europe. Of all nations of Europe, the Greeks were most intimately connected with the civilisation of the East. A maritime people by the nature of the land they lived in, colonisation followed as a matter of course on the tracks of their trading vessels; and thus, more than any other people, they helped to spread Eastern knowledge along the shores of the Mediterranean, and throughout the South of Europe.

The early constructive works of Greece, till about the seventh century B.C., form a strong contrast to those of its more prosperous days. Commonly called Pelasgian, they are more remarkable as engineering works than admirable as those which followed them were for architectural beauty. Walls of huge unshapely stones—admirably fitted together, however—tunnels, and bridges, characterise this period. In Greece, during the few and glorious centuries which followed, the one aim in all construction was to please the eye, to gratify the sense of beauty; and in no age was that aim more thoroughly and satisfactorily attained.

In these days, when sanitary questions attract each year more attention, we may call to mind that twenty-three centuries ago the city of Agrigentum possessed a system of sewers, which, on account of their large size, were thought worthy of mention by Diodorus.† This is not, however, the first record of towns being drained; the well-known Cloaca Maxima, which formed part of the drainage system of Rome, was built some two centuries earlier, and great vaulted drains passed beneath the palace mounds of unburnt brick at Nimroud and Babylon; and possibly we owe the preservation of many of the interesting remains found in the brick mounds of Chaldæa to the very elaborate system of pipe drainage discovered in them, and described by Loftus.‡

Whilst Pelasgian art was being superseded in Greece, the city of Rome was founded in the eighth century before our era; and Etruscan art in Italy, like the Pelasgian art in Greece, was slowly merged in that of an Aryan race. The Etruscans, like the Pelasgians and the old Egyptians, were Turanians, and remarkable for their purely constructive or engineering works. Their city walls far surpass those of any other ancient race, and their drainage works and tunnels are most remarkable.

The only age which can compare with the present one in the rapid extension of utilitarian works over the face of the civilised world, is that during which the Romans, an Aryan race, as we are, were in power. As Fergusson has said, the mission of the Ayran races appears to be to pervade the world with useful and industrial arts. That the Romans adorned their bridges, their aqueducts, and their roads; that with a sound knowledge of construction they frequently made it subservient to decoration, was partly owing to the mixture of Etruscan or Turanian blood in their veins, and partly to their great wealth, which made them disregard cost in their construction, and to their love of display.

It would be impossible for me to do justice to even a small part of the engineering works which have survived fourteen centuries of strife, and remain to this day as monuments of the skill, the energy, and ability of the great Roman people. Fortunately, their works are more accessible than those of which I have spoken hitherto, and many of you are probably already familiar with them.

Conquerors of the greater part of the civilised world, the admirable organisation of the Romans enabled them to make good use of the unbounded resources which were at their disposal. Yet, while the capital was enriched, the development of the resources of the most distant provinces of the empire was never neglected.

War, with all its attendant evils, has often indirectly benefitted mankind. In the long sieges which took place during the old wars of Greece and Rome, the inventive power of man was taxed to the utmost to provide machines for attack and defence. The ablest mathematicians and philosophers were pressed into the service, and helped to turn the scale in favour of their employers. The world has to regret the loss of more than one, who, like Archimedes, fell slain by the soldiery while applying the best scientific knowledge of the day to devising means of defence during the siege.* In these days, too, science owes much to the labours of engineers and able men, whose time is spent in making and improving guns, the materials composing them, and armour plates to resist them, or in studying the motion of ships of war in a seaway.

The necessity for roads and bridges for military purposes has led to their being made where the necessary stimulus from other causes was wanting; and so means of communication, and the interchange of commodities, so essential to the prosperity of any community, have thus been provided. Such was the case under the Roman Empire. So, too, in later times, the ambition of Napoleon covered France and the countries subject to her with an admirable system of military roads. At the same time, we must do Napoleon the justice of saying that his genius and foresight gave a great impetus to the construction of all works favourable to commercial progress. So, again, in this country, it was the rebellion of 1745, and the want felt of roads for military purposes, which first led to the construction of a system of roads in it unequalled since the time of the Roman occupation. And lastly, in India, in Germany, and in Russia, more than one example could be pointed out where industry will benefit by railways which have originated in military precautions rather than in commercial requirements.

But to return to Rome. Roads followed the tracks of her legions into the most distant provinces of the empire. Three hundred and seventy-two great roads are enumerated, together more than 48,000 miles in length, according to the itinerary of Antoninus.

The water supply of Rome during the first century of our era would suffice for a population of seven millions, supplied at the rate at which the present population of London is supplied. This water was conveyed to Rome by nine aqueducts; and in later years the supply was increased by the construction of five more aqueducts. Three of the old aqueducts have sufficed to supply the wants of the city in modern times. These aqueducts of Rome are to be numbered among her grandest engineering works.† Time will not admit of my saying anything about her harbour works and bridges, her basilicas and baths, and numerous other works in Europe, in Asia, and in Africa. Not only were these works executed in a substantial and perfect manner, but they were maintained by an efficient staff of men divided into bodies, each having their special duties to perform. The highest officers of state superintended the construction of works, were proud to have their names associated with them, and constructed extensive works at their own expense.

Progress in Europe stopped with the fall of the Roman Empire. In the fourth and succeeding centuries the barbarian hordes of Western Asia, people who felt no want of roads and bridges, swept over Europe to plunder and destroy.

With the seventh century began the rise of the Mohammedan power, and a partial return to conditions apparently more favourable to the progress of industrial

* *Ibid.*

† Agrigentum was a celebrated Greek city, founded B.C. 582, population 200,000 (Diodorus, 406 B.C.), drained by Phœax, who lived B.C. 480.

‡ Rawlinson's "Five Ancient Monarchies," vol. i., pp. 89, 90, second edition.

* Archimedes, B.C. 287-212; killed at the siege of Syracuse by the Roman soldiers.

† Total length 250 miles; 50 on arches, 200 underground.

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art, when widespread lands were again united under the sway of powerful rulers.* Science owes much to Arab scholars, who kept and handed on to us the knowledge acquired so slowly in ancient times, and much of which would have been lost but for them. Still, few useful works remain to mark the supremacy of the Mohammedan power at all comparable to those of the age which preceded its rise.

A great building age began in Europe in the tenth century, and lasted through the thirteenth. It was during this period that these great ecclesiastical buildings were erected, which are not more remarkable for artistic excellence than for boldness in design.

While the building of cathedrals progressed on all sides in Europe, works of a utilitarian character, which concern the engineer, did not receive such encouragement, excepting perhaps in Italy.

From the twelfth to the thirteenth centuries, with the revival of the arts and sciences in the Italian republics, many important works were undertaken for the improvement of the rivers and harbours of Italy. In 1481 canal locks were first used; and some of the earliest of which we have record were erected by Leonardo da Vinci, who would be remembered as a skilful engineer had he not left other greater and more attractive works to claim the homage of posterity.

The great use that has since been made of this simple means of transferring floating vessels from one water level to another, in connection not only with inland navigation, but in all the great ports and harbours of the world, renders it all the more deserving of remark.

In India, under the Moguls, irrigation works, for which they had a natural aptitude, were carried on during these centuries with vigour, and more than one emperor is noted for the numerous great works of this nature which he carried out. If the native records can be trusted, the number of hydraulic works undertaken by some rulers is surprising. Tradition relates that one king, who reigned in Orissa in the twelfth century, made one million tanks or reservoirs, besides building sixty temples, and erecting numerous other works.†

In India, the frequent overflow of the great rivers, and the periodical droughts, which rendered irrigation necessary, led to extensive protective works being undertaken at an early period; but as these works have been maintained by successive rulers, Mogul and Mohammedan, until recent times, and have not been left for our inspection, deserted and useless for 3000 years or more, as is often the case in Egypt and Mesopotamia, there is more difficulty in ascertaining the date of such works in India.

Works of irrigation were among the earliest attempts at engineering undertaken by the least civilised inhabitants in all parts of the world. Even in Australia, where savages are found as low as any in the scale of civilisation, traces of irrigation works have been found. These works, however, must be taken to show that the natives were once somewhat more civilised than we now find them. In Feejee, our new possession, the natives occasionally irrigate their land,‡ and have executed a work of a higher class, a canal some two miles long and sixty feet wide, to shorten the distance passed over by their canoes.|| The natives of New Caledonia irrigate their fields with great skill.§ In Peru, the Incas excelled in irrigation as in other great and useful works, and constructed most admirable underground conduits of masonry for the purpose of increasing the fertility of the land.¶

It is frequently easier to lead water where it is wanted than to check its irruption into places where its presence is an evil, often a disaster. For centuries the existence of a large part of Holland has been dependent on the skill of man. How soon he began in that country to contest with the sea the possession of the land we do not know, but early in the twelfth century dykes were constructed to keep back the ocean. As the prosperity of the country increased with the great extension of its commerce, and land became more valuable and necessary for an increasing population, very extensive works were undertaken. Land was reclaimed from the sea, canals were cut, and machines were designed for lifting water. To the practical knowledge acquired by the Dutch, whose method of carrying out hydraulic works is original and of native growth, much of the knowledge of the present day in embanking, and draining, and canal making is due. The North Holland Canal* was the largest navigable canal in existence until the Suez Canal was completed; and the Dutch have just now nearly finished making a sea canal from Amsterdam to the North Sea, which, though not equal to the Suez Canal in length, will be as great in width and depth, and involves perhaps larger and more important works of art. This country was for many years beholden to the Dutch for help in carrying out hydraulic works. In the seventeenth century much fen land in the Eastern Counties was drained by Dutch labour, directed by Dutch engineers, among whom Sir Cornelius Vermuyden, an old campaigner of the Thirty Years' War, and a colonel of horse under Cromwell, is the most noted.

While the Dutch were acquiring practical knowledge in dealing with water, and we in Britain, among others, were benefiting by their experience, the disastrous results which ensued from the inundations caused by the Italian rivers of the Alps gave a new importance to the science of hydraulics. Some of the greatest philosopeers of the seventeenth century—among them Torricelli, a pupil of Galileo†—were called upon to advise and to superintend engineering works. Nor did they confine themselves to the construction of preventive works, but thorougly investigated the condition pertaining to fluids at rest or in motion, and gave to the world a valuable series of work on hydraulics and hydraulic engineering, which form the basis of our knowledge of these subjects at the present day.

Some of the best scientific works (prior to the nineteenth century) on engineering subjects we owe to Italian and French writers. The writings of Belidor, an officer of artillery in France in the seventeenth century, who did not, however, confine himself to military subjects, drew attention to engineering questions. Not long after their appearance the Ponts et Chausées‡ were established, which has maintained ever since a body of able men specially educated for, and devoted to, the prosecution of industrial works.

The impulse given to road-making in the early part of the last century soon extended to canals and means for facilitating locomotion and transport generally. Tramways were used in connection with mines at least as early as the middle of the seventeenth century, but the rails were, in those days, of wood. The first iron rails are said to have been laid in this country as early as 1738; after which time their use was gradually extended, until it became general in mining districts.

By the beginning of this century the great ports of England were connected by a system of canals; and new harbour works became necessary, and were provided, to accommodate the increase of commerce and trade, which improved means of internal transport had rendered possible. It was in the construction of these works that our own Brindley and Smeaton, Telford and Rennie, and other engineers of their time, did so much.

But it was not until the steam-engine, improved and almost created by the illustrious Watt, became such a

* "Under the last of the house of Ommiyah (750 A.D.) one command was obeyed almost along the whole diameter of the known world, from the banks of the Sihon to the utmost promontory of Portugal."—Hallam's "Middle Ages," vol. ii., p. 120, 2nd edition.

† King Bhim Deo, A.D. 1174, 60 temples, 10 bridges, 40 wells stone cased, 152 landing stairs, and one million tanks.—Hunter's "Orissa," vol. i., p. 100.

‡ Erskine's "Western Pacific," p. 171.

|| Seeman, p. 82.

§ Erskine's "Western Pacific," p. 355.

¶ Markham's "Cieza" (note

* North Holland Canal, finished in 1825.

† Galileo, b. 1564; Torricelli, b. 1608.

‡ Ponts et Chaussées, established 1720.

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potent instrument, that engineering works to the extent they have since been carried out became possible or necessary. It gave mankind no new faculty, but it at once set his other faculties on an eminence, from which the extent of his future operations became almost unlimited.

Water-mills, wind-mills, and horse-machines were in most cases superseded. Deep mines, before only accessible by adits and water levels, could at once be reached with ease and economy. Lakes and fens which, but for the steam-engine, would have been left untouched, were drained and cultivated.

The slow and laborious toil of hands and fingers, bone and sinew, was turned to other employments, where, aided by ingenious mechanical contrivances, the produce of one pair of hands was multiplied a thousand-fold, and their cunning extended until results marvellous, if you consider them, were atttained. Since the time of Watt the steam-engine has exerted a power, made conquests, and increased and multiplied the material interests of this globe to an extent which it is scarcely possible to realise.

But while Watt has gained a world-wide, well-earned fame, the names of those men who have provided the machines to utilise the energies of the steam-engine are too often forgotten. Of their inventions the majority of mankind know little. They worked silently at home, in the mill, or in the factory, observed by few. Indeed, in most cases these silent workers had no wish to expose their work to public gaze. Were it not so, the factory and the mill are not places where people go to take the air. How long in the silent night the inventors of these machines sat and pondered; how often they had to cast aside some long sought mechanical movement and seek another and a better arangement of parts, none but themselves could ever know. They were unseen workers, who succeeded by rare genius, long patience, and indomitable perseverance.

More ingenuity and creative mechanical genius is perhaps displayed in machines used for the manufacture of textile fabrics than by those used in any other industry. It was not until late in historical times that the manufacture of such fabrics became established on a large scale in Europe. Although in China man was clothed in silk long ago, and although Confucius, in a work written 2300 years ago, orders with the greatest minuteness the rules to be observed in the production and manufacture of silk, yet it was worth nearly its weight in gold in Europe in the time of Aurelian, whose empress had to forego the luxury of a silk gown on account of its cost.* Through Constantinople and Italy the manufacture passed slowly westward, and was not established in France until the sixteenth century, and arrived at a still later period in this country. It is related that James V. had to borrow a pair of silk hose from the Earl of Mar, in order that he might not, as he expressed it, appear as a scrub before strangers.

So cotton, of which the manufacture in India dates from before historical times, had scarcely by the Christian Era reached Persia and Egypt. Spain in the tenth, and Italy in the fourteenth century manufactured it, but Manchester, which is now the great metropolis of the trade, not until the latter half of the seventeenth century.

Linen was worn by the old Egyptians, and some of their linen mummy-cloths surpass in fineness any linen fabrics made in later days.† The Babylonians wore linen also, and wool, and obtained a widespread fame for skill in workmanship and beauty in design.

In this country wool long formed the staple for clothing. Silk was the first rival, but its costliness placed it beyond the reach of the many. To introduce a new material or improved machine into this or other countries a century or more ago was no light undertaking. Inventors, and would-be benefactors, alike ran the risk of loss of life. Loud was the outcry made in the early part of the eighteenth century against the introduction of Indian cottons and Dutch calicoes.

Until 1738, in which year the improvements in spinning machinery were begun, each thread of worsted or cotton-wool had been spun between the fingers in this and all other countries. Wyatt, in 1738, invented spinning by rollers instead of fingers, and his invention was further improved by Arkwright. In 1770 Hargreaves patented the spinning jenny and Crompton the mule in 1775, a machine which combined the advantages of the frames of both Hargreaves and Arkwright. In less than a century after the first invention by Wyatt, double mules were working in Manchester with over 2000 spindles. Improvements in machines for weaving were begun at an earlier date. In 1579 a ribbon loom is said to have been invented at Dantzic, by which from four to six pieces could be woven at one time, but the machine was destroyed and the inventor lost his life.* In 1800 Jacquard's most ingenious invention was brought into use, which, by a simple mechanical operation, determines the movements of the threads which form the pattern in weaving. But the greatest discovery in the art of weaving was wrought by Cartwright's discovery of the power loom, which led eventually to the substitution of steam for manual labour, and enabled a boy with a steam loom to do fifteen times the work of a man with a hand loom.

For complex ingenuity few machines will compare with those used in the manufacture of lace and bobbin net. Hammond, in 1768, attempted to adapt the stocking frame to this manufacture, which had hitherto been conducted by hand. It remained for John Heathcoat to complete the adaptation in 1809, and to revolutionise this branch of industry, reducing the cost of its produce to one-fortieth of what the cost had been before Heathcoat's improvements were effected.

Most of these ingenious machines were in use before Watt's genius gave the world a new motive power in the steam-engine; and, had the steam-engine never been perfected, they would still have enormously increased the productive power of mankind. Water power was applied to many of them; in the first silk-thread mill erected at Derby in 1738, 318 million yards of silk thread were spun daily with one water-wheel.

These are happier times for inventors: keen competition among manufacturers does not let a good invention lie idle now. That which was rejected by old machines as waste is now worked up into useful fabrics by new ones. From all parts of the world new products come—jute from India, flax from New Zealand, and many others which demand new adaptations of old machines or new and untried mechanical arrangements to utilise them. Time would fail me if I were to attempt to enumerate one tithe of these rare combinations of mechanical skill; and, indeed, no one will ever appreciate the labour and supreme mental effort required for their construction who has not himself seen them and their wondrous achievements.

Steamboats, the electric telegraph, and railways, are more within the cognisance of the world at large, and the progress that has been made in them in little more than one generation is better known and appreciated.

It is not more than forty years since one of our scientific men, and an able one too, declared at a meeting of this Association that no steamboat would ever cross the Atlantic; founding his statement on the impracticability, in his view, of a steamboat carrying sufficient coal, profitably, I presume, for the voyage. Yet, soon after this statement was made, the *Sirius* steamed from Bristol to New York in seventeen days,† and was soon followed by the *Great Western* which made the homeward passage in thirteen-and-a-half days; and with these voyages the era of steamboats began. Like most important inven ions, that of the steamboat was a long time in assuming a form capable of being profitably utilised; and even when it had assumed such a form, the

* Manufacture of silk brought from China to Constantinople A.D. 522.

† Wilkinson's "Ancient Egyptians;" Pliny, Book xix., c. ii.

* Beckman's "History of Inventions," vol. ii., p. 528.

† First steamer crossed the Atlantic by steam alone in 1838.

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objections of commercial and scientific men had still to be overcome.

Among the many names connected with the early progress in the construction of steamboats, perhaps none is more worthy of remembrance than that of Patrick Miller, who, with the assistance of Symington, an engineer, and Taylor, who was his children's tutor, constructed a small steamboat. Shortly afterwards Lord Dundas, who saw the value of the application of steam for the propulsion of boats, had the first really practical steamboat constructed with a view to using it on the Forth and Clyde Canal. The proprietors, however, objected, and the boat lay idle. Again, another attempt to make practical use of the steamboat failed through the death of the Duke of Bridgewater, who, with his characteristic foresight, had seen the value of steam as a motive power for boats, and had determined to introduce steamboats on the canal which bears his name.

The increase in the number of steamboats since the time when the *Sirius* first crossed the Atlantic has been very great. Whereas in 1814 the United Kingdom only possessed two steam vessels, of together 456 tons burden, in 1872 there were on the register of the United Kingdom 3662 steam vessels, of which the registered tonnage amounted to over a million and a half of tons,* or to nearly half the whole steam tonnage of the world, which did not at that time greatly exceed three million tons.

As the number of steamboats has largely increased, so also gradually has their size increased until it culminated in the hands of Brunel in the *Great Eastern*.

A triumph of engineering skill in ship-building, the *Great Eastern* has not been commercially so successful. In this, as in many other engineering problems, the question is not how large a thing can be made, but how large, having regard to other circumstances, it is proper at the time to make it.

If, as regards the dimensions of steamboats, we have at present somewhat overstepped the limits in the *Great Eastern* much still remains to be done in perfecting the form of vessels, whether propelled by steam or driven by the force of the wind. A distinguished member of this Association, Mr. Froude, has now for some years devoted himself to investigations carried on with a view to ascertain the form of vessel which will offer the least resistance to the water through which it must pass. So many of us in these days are called upon to make journeys by sea as well as by land, that we can well appreciate the value of Mr. Froude's labours, so far as they tend to curtail the time which we must spend on our ocean journeys; and we should all feel grateful to him if from another branch of his investigations, which relates to the rolling of ships, it should result that the movement in passenger vessels could be reduced. A gallant attempt in this direction has lately been made by Mr. Bessemer; whether a successful one yet remains to be proved. In any event, he and those who have acted with him deserve our praise for an experiment which must add to our knowledge.

It is a question of vital importance to the steamboat that the consumption of fuel should be reduced to the smallest possible amount, inasmuch as each ton of fuel excludes a ton of cargo.

As improvements in the form of the hull are effected, less power—that is, less fuel—will be required to propel the vessel through the water for a given distance. Great as have been the improvements effected in marine engines to this end, much still remains to be done. Wolf's compound engine, so long overlooked, is, with some improvements, being at last applied. Whereas the consumption of fuel in such vessels as the *Himalaya* used to be from 5 to 6 lbs. of fuel per effective horse-power, it has been reduced, by working steam more expansively in vessels of a later date, to 2 lbs. Yet, comparing this with the total amount of energy of 2 lbs. of coal, it will be found that not a tenth part of the power is obtained which that amount of coal would theoretically call into action.*

We live in an age when great discoveries are made, and when they are speedily taken advantage of if they are likely to be of service to mankind.

In former times, man's inventions were frequently in advance of the age, and they were laid aside to await a happier era. There were in those earlier days too few persons who cared to, or who could, avail themselves of the proffered boon, and there was no sufficient accumulation of wealth to justify its being appropriated to schemes which are always in their early stage more or less speculative.

There is no more remarkable instance of the rapid utilisation of what was in the first instance regarded by most men as a mere scientific idea, than the adoption and extension of the electric telegraph.

Those who read Odier's letter written in 1773, in which he made known his idea of a telegraph which would enable the inhabitants of Europe to converse with the Emperor of Mogul, little thought that in less than a century a conversation between persons at points so far distant would be possible. Still less did those who saw in the following year messages sent from one room to another by Lesage in the presence of Frederich of Prussia, realise that they had before them the germ of one of the most extraordinary inventions among the many that will render this century famous.

I should weary you were I to follow the slow steps by which the electric telegraph of to-day was brought to its present state of efficiency. In the present century few years have passed without new workers appearing in the field; some whose object was to utilise the new-found power for the benefit of mankind, others—and their work was not the least important in the end—whose object was to investigate magnetism and electrical phenomena as presenting scientific problems still unsolved. Galvani, Volta, Oersted, Arago, Sturgeon, and Faraday, by their labours, helped to make known the elements which rendered it possible to construct the electric telegraph. With the battery, the electric coil, and the electro-magnet, the elements were complete, and it only remained for Sir Charles Wheatstone and others to combine them in a useful and practically valuable form. The inventions of Alexander Stenheil, and those of similar nature to that of Sir Charles Wheatstone, were made known at a later date in the same year, which will ever be memorable in the annals of telegraphy.†

The first useful telegraph was constructed upon the Blackwall Railway in 1838, Messrs. Wheatstone's and Cooke's instruments being employed. From that time to this the progress of the electric telegraph has been so rapid, that at the present time, including land lines and submarine cables, there are in use in different parts of the world not less than 400,000 miles of telegraph.

* Board of Trade Return, July 15, 1874, Table 8.

* Theroretical Energy of 1 lb. of Coal:—

The proportions of heat expended in generating saturated steam at 212° F., and at 14·7 lbs. pressure per square inch, from water at 212° are:

	Units of heat.	Mechanical equivalent in foot-lbs.
I. In the formation of steam ..	892·8	689,242
II. In resisting the incumbent pressure of 14·7 lbs. per sq. inch..	72·3	55,815
	965·1	745,057

One pound of Welsh coal will theoretically evaporate 15 lbs. of water at 212° to steam at 212°. Therefore, the full theoretical value of the combustion of 2 lbs. of Welsh coal is

$2 \times 15 \times 745{,}057$ foot-pounds,

or

$$\frac{2 \times 15 \times 745{,}057}{60 \times 33{,}000} \text{ horse-power, if consumed in 1 hour.}$$

$$= 11{\cdot}2 \text{ horse-power.}$$

As the consumption of coal per effective horse-power in a marine engine is 2 lbs., the power obtained is to the whole theoretical power as 1 is to 11.

† Dates of patents: Wheatstone, March 1, 1837; Alexander, April 22, 1837; Steinheil, July 1, 1837; Morse, October, 1837.

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Among the numerous inventions of late years, the automatic telegraph of Mr. Alexander Bain, of Dr. Werner Siemens, and of Sir Charles Wheatstone, are especially worthy of notice. Mr. Bain's machine is chiefly used in the United States, that of Dr. Werner Siemens in Germany. In this country the machine invented by Sir Charles Wheatstone, to whom telegraphy owes so much, is chiefly employed. By his machine, after the message has been punched out in a paper ribbon by one machine on a system analogous to the dot and dash of Morse, the sequence of the currents requisite to transmit the message along the wire is automatically determined in a second machine by this perforated ribbon. The second operation is analogous to that by which in Jacquard's loom the motions of the threads requisite to produce the pattern is determined by perforated cards. By Wheatstone's machine errors inseparable from manual labour are avoided; and what is of even more importance in a commercial point of view, the time during which the wire is occupied in the transmission of a message is considerably diminished.

By the application of these automatic systems to telegraphy, the speed of transmission has been wonderfully accelerated, being equal to 200 words a minute, that is, faster than a shorthand writer can transcribe; and, in fact, words can now be passed along the wires of land lines with a velocity greater than can be dealt with by the human agency at either end.

Owing partly to the retarded effects of induction and other causes, the speed of transmission by long submarine cables is much smaller. With the cable of 1858 only 2½ words per minute were got through. The average with the Atlantic cable, Dr. C. W. Siemens informs me, is now 17 words, but 24 words per minute can be read.

One of the most striking phenomena in telegraphy is that known as the duplex system, which enables messages to be sent from each end of the same wire at the same time. This simultaneous transmission from both ends of a wire was proposed in the early days of telegraphy, but, owing to imperfect insulation, was not then found to be practicable; but since then telegraphic wires have been better insulated, and the system is now becoming of great utility, as it nearly doubles the capacity for work of every wire.

And yet within how short a period of time has all the wonderful progress in telegraphy been achieved! How incredulous the world a few years ago would have been if then told of the marvels which in so short a space of time were to be accomplished by its agency!

It is not long ago—1823—that Mr., now Sir Francis Ronalds, one of the early pioneers in this field of science, published a description of an electric telegraph. He communicated his views to Lord Melville, and that nobleman was obliging enough to reply that the subject should be inquired into; but before the nature of Sir Francis Ronalds's suggestions could be known, except to a few, that gentleman received a reply from Mr. Barrow, 'that telegraphs of any kind were then wholly unnecessary, and that no other than the one then in use would be adopted;' the one then in use being the old semaphore, which, crowning the tops of the hills between London and Portsmouth, seemed perfection to the Admiralty of that day.

I am acquainted with some who, when the first Transatlantic cable was proposed, contributed towards that undertaking with the consciousness that it was only an experiment, and that subscribing to it was much the same thing as throwing their money into the sea. Much of this cable was lost in the first attempt to lay it; but its promoters, nothing daunted, made 900 miles more cable, and finally laid it successfully in the following year, 1858.

The telegraphic system of the world comprises almost a complete girdle round the earth; and it is probable that the missing link will be supplied by a cable between San Francisco in California and Yokohama in Japan.

How resolute and courageous those who engaged in submarine telegraphy have been will appear from the fact that, though we have now 50,000 miles of cable in use, to get at this result nearly 70,000 miles were constructed and laid. This large percentage of failure, in the opinion of Dr. C. W. Siemens (to whom I am much indebted for information on this subject), was partly due to the late introduction of testing a cable under water before it is laid, and to the use of too light iron sheathing.

Of immense importance in connection with the subsequent extension of submarine cables have been the discoveries of Ohm and Sir William Thomson, and the knowledge obtained that the resistance in wire of homogeneous metal is directly proportional to the length, so that the place of a fault in a cable of many thousand miles in length can be ascertained with so much precision as to enable you to go at once to repair it, although the damaged cable may lie in some thousands of fathoms of water.

Of railways the progress has been enormous; but I do not know that in a scientific point of view a railway is so marvellous in its character as the electric telegraph. The results, however, of the construction and use of railways are more extensive and wide spread, and their utility and convenience brought home to a larger portion of mankind. It has come to pass, therefore, that the name of George Stephenson has been placed second only to that of James Watt; and as men are and will be estimated by the advantages which their labours confer on mankind, he will remain in that niche, unless indeed some greater luminary should arise to outshine him. The merit of George Stephenson consisted, among other things, in this, that he saw more clearly than any other engineer of his time the sort of thing that the world wanted, and that he persevered in despite of learned objectors with the firm conviction that he was right and they were wrong, and that there was within himself the power to demonstrate the accuracy of his convictions.

Railways are a subject on which I may (I hope without tiring you) speak somewhat more at length. The British Association is peripatetic, and without railways its meetings, if held at all, would, I fear, be greatly reduced in numbers. Moreover, you have all an interest in them: you all demand to be carried safely, and you insist on being carried fast. Besides, everybody understands, or thinks he understands, a railway, and therefore I shall be speaking on a subject common to all of us, and shall possibly only put before you ideas which others as well as myself have already entertained.

We who live in these days of roads and railways, and can move with a fair degree of comfort, speed, and safety, almost where we will, can scarcely realise the state of England two centuries ago, when the years of opposition which preceded the era of coaches began; when, as in 1662, there were but six stages in all England, and John Crossdell, of the Charterhouse, thought there were six too many; when Sir Henry Herbert, a member of the House of Commons, could say, 'If a man were to propose to carry us regularly to Edinburgh in coaches in seven days, and bring us back in seven more, should we not vote him to Bedlam?

In spite of short-sighted opposition, coaches made their way; but it was not until a century later, in 1784—and then I believe it was in this city of Bristol—that coaches were first established for the conveyance of mails. Those here who have experienced, as I have, what the discomforts were of long journeys inside the old coaches, will agree with me that they were very great; and I believe, if returns could be obtained of the accidents which happened to coaches, it would be found that many more people were injured and killed in proportion to the number that travelled by that mode, than by the railways of to-day.

No sooner had our ancestors settled down with what comfort was possible in their coaches, well satisfied that twelve miles an hour was the maximum speed to be obtained or that was desirable, than they were told that steam conveyance on iron railways would supersede their

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'present pitiful' methods of conveyance. Such was the opinion of Thomas Gray, the first promoter of railways, who published his work on a general iron railway in 1819. Gray was looked on as little better than a madman. 'When Gray first proposed his great scheme to the public,' said Chevalier Wilson, in a letter to Sir Robert Peel in 1845, 'people were disposed to treat it as an effusion of insanity.' I shall not enter on a history of the struggles which preceded the opening of the first railway. They were brought to a successful issue by the determination of a few able and far-seeing men. The names of Thomas Gray and Joseph Sandars, of William James and Edward Pease, should always be remembered in connection with the early history of railways, for it was they who first made the nation familiar with the idea. There is no fear that the name of Stephenson will be forgotten, whose practical genius made the realisation of the idea possible.

The Stockton and Darlington Railway was opened in 1825, the Liverpool and Manchester Railway in 1830, and in the short time which has since elapsed, railways have been extended to every quarter of the globe. No nation possessing wealth and population can afford to be without them; and though at present in different countries there is in the aggregate about 160,000 miles of railway, it is certain that in the course of a very few years this quantity, large as it is, will be very greatly exceeded.

Railways add enormously to the national wealth. More than 25 years ago it was proved to the satisfaction of a committee of the House of Commons, from facts and figures which I then adduced, that the Lancashire and Yorkshire Railway, of which I was the engineer, and which then formed the principal railway connection between the populous towns of Lancashire and Yorkshire, effected a saving to the public using the railway of more than the whole amount of the dividend which was received by the proprietors. These calculations were based solely on the amount of traffic carried by the railway, and on the difference between the railway rate of charge and the charges by the modes of conveyance anterior to railways. No credit whatever was taken for the saving of time, though in England pre-eminently time is money.

Considering that railway charges on many items have been considerably reduced since that day, it may be safely assumed that the railways in the British Islands now produce, or rather save to the nation, a much larger sum annually than the gross amount of all the dividends payable to the proprietors, without at all taking into account the benefit arising from the saving in time. The benefits under that head defy calculation, and cannot with any accuracy be put into money; but it would not be at all overestimating this question to say that in time and money the nation gains at least what is equivalent to 10 per cent. on all the capital expended on railways. I do not urge this on the part of railway proprietors, for they did not embark in these undertakings with a view to the national gain, but for the expected profit to themselves. Yet it is as well it should be noted, for railway proprietors appear sometimes by some people to be regarded in the light of public enemies.

It follows from these facts that whenever a railway can be made at a cost to yield the ordinary interest of money, it is in the national interest that it should be made. Further, that though its cost might be such as to leave a smaller dividend than that to its proprietors, the loss of wealth to so small a section of the community will be more than supplemented by the national gain, and therefore there may be cases where a government may wisely contribute in some form to undertakings which, without such aid, would fail to obtain the necessary support.

And so some countries, Russia for instance, to which improved means of transport are of vital importance, have wisely, in my opinion, caused lines to be made which, having regard to their own expenditure and receipts, would be unprofitable works, but in a national point of view are, or speedily will be, highly advantageous.

The Empire of Brazil also, which I have lately visited, is arriving at the conclusion, which I think not an unwise one, that the State can afford and will be benefited in the end by guaranteeing 7 per cent. upon any railway that can of itself be shown to produce a net income of 4 per cent., on the assumption that the nation will be benefited at least to the extent of the difference.

A question more important probably in the eyes of many—safety of railway travelling—may not be inappropriate. At all events, it is well that the elements on which it depends should be clearly understood. It will be thought that longer experience in the management of railways should go to ensure greater safety, but there are other elements of the question which go to counteract this in some degree.

The safety of railway travelling depends on the perfection of the machine in all its parts, including the whole railway, with its movable plant, in that term; it depends also on the nature and quantity of traffic, and lastly, on human care and attention.

With regard to what is human, it may be said that so many of these accidents as arise from the fallibility of men will never be eliminated until the race be improved.

The liability to accident will also increase with the speed, and might be reduced by slackening that speed. It increases with the extent and variety of the traffic on the same line. The public, I fear, will rather run the risk than consent to be carried at a slower rate. The increase in extent and variety of traffic is not likely to receive any diminution; on the contrary, it is certain to augment.

I should be sorry to say that human care may not do something, and I am not among those who object to appeals through the press, and otherwise to railway companies, though sometimes perhaps they may appear in an unreasonable form. I see no harm in men being urged in every way to do their utmost in a matter so vital to many.

A question may arise whether, if the railways were in the hands of the Government, they could not be worked with greater safety. Government would not pay their officers better, or perhaps so well as the companies do, and it is doubtful whether they would succeed in attracting to the service abler men. They might do the work with a smaller number of chief officers, for much of the time of the companies' managers is occupied in internecine disputes. They might handle the traffic more despotically, diminishing the number of trains, or the accommodation afforded by them, or in other ways, to insure more safety; but would the public bear any curtailment of convenience?

One thing they could, and perhaps would do. In cases where the traffic is varied, and could more safely be conducted with the aid of relief lines, which hold out no sufficient inducement to the companies to make, the Government, being content with a lower rate of interest, might undertake to make them, though then comes the question whether, when the whole of this vast machine came to depend for supplies on annual votes of Parliament, money would be forthcoming in greater abundance than it is under the present system.

But the consideration of this subject involves other and more difficult questions.

Where are the labours of Government to stop? The cares of State which cannot be avoided are already heavy, and will grow heavier every year. Dockyard establishments are trifling to what the railway establishments, which already employ 250,000 men, would be. The assumption of all the railways would bring Government into conflict with every passenger, every trader, every merchant, and every manufacturer. With the railway companies there would be no difficulty; they would sell their undertakings to anyone provided their price was ample.

Looking at the vast growth of railway traffic, one measure occurs to me as conducive to the safety of rail-

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way passengers, and likely to be demanded some day: it is to construct between important places railways which should carry passengers only or coals only, or be set apart for some special separation of traffic; though there will be some difficulty in accomplishing this. Landowners, through whose properties such lines would pass, would probably wish to use such lines for general purposes. Nevertheless, it may have to be tried some day.

It would be instructive, were it practicable, to compare the relative proportion of accidents by railway and by the old stage coaches, but no records that I am aware of exist of the latter that would enable such a comparison to be made. It is practicable to make some sort of comparison between the accidents in the early days of our own railways and the accidents occurring at a later date.

The Board of Trade have unfortunately abandoned the custom, which they adopted from 1852 to 1859, of returning the passenger mileage, which is given in the German returns, and is the proper basis upon which to found the proportion of accidents, and not on the number of passengers without any regard to distance travelled, which has altered very much, the average journey per passenger being nearly half in 1873 what it was in 1846.

It would be erroneous to compare the proportions of accidents to passengers carried in various years, even if the correct number of passengers travelling were given. But a figure is always omitted from the Board of Trade return, which makes the proportion of accidents to passengers appear larger than it is; this is the number of journeys performed by season-ticket holders. Some estimate could be made of the journeys of season-ticket holders by dividing the receipts by an estimated average fare, or the companies could make an approximate estimate, and the passenger mileage could be readily obtained by the railway companies from the tickets. These additions would greatly add to the value of the railway returns as statistical documents, and render the deductions made from them correct.

Though it has been a work of labour, I have endeavoured to supply these deficiencies, and I believe the results arrived at may be taken as fairly accurate.

From the figures so arrived at, it appears the passenger mileage has doubled between 1861 and 1873; and at the rate of increase between 1870 and 1873 it would become double what it was in 1873 in twelve years from that time, namely in 1885.

The number of passengers has doubled between 1864 and 1873, and at the rate of increase between 1870 and 1873 it would become double what it was in 1873 in eleven-and-a-half years, or in 1885.

It must, however, be remembered that the rate of increase since 1870, though very regular for 1871, 1872, and 1873, is greater than in previous years, being probably due to the rise of wages and the great development of third-class traffic, and it would not be safe to assume this rate of increase will continue.

Supposing no improvement had been effected in the working of railway traffic, by the interlocking of points, the block system, &c., the increase of accidents should have borne some proportion to the passenger mileage, multiplied by the proportion between the train mileage and the length of line open, as the number of trains passing over the same line of rails would tend to multiply accidents in an increasing proportion, especially where the trains run at different speeds.

The number of accidents varies considerably from year to year, but, taking two averages of ten years each, it appears that the proportion of deaths of passengers from causes beyond their control to passenger miles travelled in the ten years ending December 31, 1873, was only two-thirds of the same proportion in the ten years ending December 31, 1861; the proportion of all accidents to passengers from causes beyond their own control was one-ninth more in the last ten years than in the earlier, whereas the frequency of trains had increased, on the average, one-fourth.

The limit, however, of considerable improvements in signalling, increased brake power, &c., will probably be reached before long, and the increase of accidents will depend on the increase of traffic, together with the increased frequency of trains.

The large growth of railway traffic, which we may assume will double in twenty years, will evidently greatly tax the resources of the railway companies; and unless the present companies increase the number of lines of way, as some have commenced to do, or new railways are made, the system of expeditious and safe railway travelling will be imperilled. Up to the present time, however, the improvements in regulating the traffic appear to have kept pace with the increase of traffic and of speed, as the slight increase in the proportion of railway accidents to passenger miles is probably chiefly due to a larger number of trifling bruises being reported now than formerly.

I believe it was a former President of the Board of Trade who said to an alarmed deputation, who waited upon him on the subject of railway travelling, that he thought he was safer in a railway carriage than anywhere else.

If he gave any such opinion, he was not far wrong, as is sufficiently evident when it can be said that there is only one passenger injured in every four million miles travelled, or that, on an average, a person may travel 100,000 miles each year for forty years, and the chances be slightly in his favour of his not receiving the slightest injury.

A pressing subject of the present time is the economy of fuel. Members of the British Association have not neglected this momentous question.

At the meeting held at Newcastle-on-Tyne in 1863, Sir William Armstrong sounded an alarm as to the proximate exhaustion of our coal-fields.

Mr. Bramwell, when presiding over the Mechanical Section at Brighton, drew attention to the waste of fuel.

Dr. Siemens, in an able lecture he delivered by request of the Association to the operative classes at the meeting at Bradford, pointed out the waste of fuel in special branches of the iron trade, to which he has devoted so much attention.

He showed on that occasion that, in the ordinary reheating furnace, the coal consumed did not produce the twentieth part of its theoretical effect, and in melting steel in pots in the ordinary way not more than one-seventieth part; in melting one ton of steel in pots about 2½ tons of coke being consumed. Dr. Siemens further stated that, in his regenerative gas furnace, one ton of steel was melted with 12 cwts. of small coal.

Mr. Lowthian Bell, who combines chemical knowledge with the practical experience of an ironmaster, in his Presidential address to the members of the Iron and Steel Institute in 1873, stated that, with the perfect mode of withdrawing and utilising the gases and the improvement in the furnaces adopted in the Cleveland district, the present make of pig-iron in Cleveland is produced with 3½ million tons of coal less than would have been needed fifteen years ago; this being equivalent to a saving of 45 per cent of the quantity formerly used. He shows, by figures with which he has favoured me, that the calorific power of the waste gases from the furnaces is sufficient for raising all the steam and heating all the air the furnaces require.

It has already been stated that, by working steam more expansively, either in double or single engines, the consumption of fuel in improved modern engines compared with the older forms may be reduced to one-third.

All these reductions still fall far short of the theoretical effect of fuel which may be never reached. Mr. Lowthian Bell's figures go to show that in the interior of the blast furnace, as improved in Cleveland, there is not much more to be done in reducing the consumption of fuel; but much has already been done, and could the reductions now attainable, and all the information already acquired,

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be universally applied, the saving in fuel would be enormous.

How many open blast furnaces still belch forth flame and gas and smoke as uselessly, and with nearly as much mischief to the surrounding neighbourhood, as the fires of Etna or Vesuvius?

How many of the older and more extravagant forms of steam-engine still exist?

What is to be done with the intractable householder with the domestic hearth, where, without going to German stoves, but by using Galton's grates and other improvements, everything necessary both for comfort and convenience could be as well attained with a much smaller consumption of coal?

If I have pointed out that we do not avail ourselves of more than a fractional part of the useful effects of fuel, it is not that I expect we shall all at once mend our ways in this respect.

Many cases of waste arise from the existence of old and obsolete machines, of bad forms of furnaces, of wasteful grates, existing in most dwelling-houses; and these are not to be remedied at once, for not everyone can afford, however desirable it might be, to cast away the old and adopt the new.

In looking uneasily to the future supply and cost of fuel, it is, however, something to know what may be done even with the application of our present knowledge; and could we apply it universally to-day, all that is necessary for trade and comfort could probably be as well provided for by one-half the present consumption of fuel; and it behoves those who are beginning to build new mills, new furnaces, new steamboats, or new houses, to act as though the price of coal which obtained two years ago had been the normal, and not the abnormal price.

There was in early years a battle of the gauges, and there is now a contest about guns; but your time will not permit me to say much on their manufacture.

Here, again, the progress made in a few years has been enormous; and in contributing to it, two men, Sir William Armstrong and Sir Joseph Whitworth, both civil engineers, in this country at all events, deservedly stand foremost. The iron coil construction of Sir William Armstrong has already produced remarkable and satisfactory results; in discussing further possible improvements, the question is embarrassed by attempting to draw sharp lines between what is called steel and iron.

There is nothing that I can see to limit the size of guns, except the tenacity and endurance of the metal, whatever we may choose to call it, of which they are to be made.

Sir Joseph Whitworth, who has already done more than any other man in his department to secure good workmanship, and whose ideal of perfection is ever expanding, has long been seeking, and not without success, by enormous compression, to increase those qualities in what he calls homogeneous metal. Make the metal good enough, and call it iron if you will, and the size of a gun may be anything: the mere construction and handling of a gun of 100 tons, or of far greater weight, with suitable mechanical appliances, presents no difficulty.

Relying on the qualities of his compressed metal, Sir Joseph is now seeking, by a singular experiment, to limit the travel of the recoil, as far as practicable, to the elasticity of the metal. By attaching the muzzle of the gun to an outer casing, through which the force of the recoil is carried back to the trunnions, he proposes to avail himself of this elasticity to the extent of one-and-a-half times the length of the gun; whether its elasticity alone in so short a space will suffice without other aid is, perhaps, doubtful; but other aid may be applied, and the experiment, whether successful or not, will be interesting.

Docks and harbours I have no time to mention, for it is time this long and, I fear, tedious address, should close.

"Whence and whither" is an aphorism which leads us away from present and plainer objects to those which are more distant and obscure; whether we look backwards or forwards, our vision is speedily arrested by an impenetrable veil.

On the subjects I have chosen you will probably think I have travelled backwards far enough. I have dealt to some extent with the present.

The retrospect, however, may be useful to show what great works were done in former ages.

Some things have been better done than in those earlier times, but not all.

In what we choose to call the ideal we do not surpass the ancients. Poets and painters and sculptors were as great in former times as now; so, probably, were the mathematicians.

In what depends on the accumulation of experience, we ought to excel our forerunners. Engineering depends largely on experience; nevertheless, in future times whenever difficulties shall arise or works have to be accomplished for which there is no precedent, he who has to perform the duty may step forth from any of the walks of life, as engineers have not unfrequently hitherto done.

The marvellous progress of the last two generations should make everyone cautious of predicting the future. Of engineering works, however, it may be said that their practicability or impracticability is often determined by other elements than the inherent difficulty in the works themselves. Greater works than any yet achieved remain to be accomplished—not, perhaps, yet awhile. Society may not yet require them; the world could not at present afford to pay for them.

The progress of engineering works, if we consider it, and the expenditure upon them, has already in our time been prodigious. One hundred and sixty thousand miles of railway alone, put into figures at £20,000 a mile, amounts to 3200 million pounds sterling; add 400,000 miles of telegraph at £100 a mile, and 100 millions more for sea canals, docks, harbours, water and sanitary works constructed in the same period, and we get the enormous sum of 3340 millions sterling expended in one generation and a half on what may undoubtedly be called useful works.

The wealth of nations may be impaired by expenditure on luxuries and war; it cannot be diminished by expenditure on works like these.

As to the future, we know we cannot create a force; we can, and no doubt shall, greatly improve the application of those with which we are acquainted. What are called inventions can do no more than this; yet how much every day is being done by new machines and instruments!

The telescope extended our vision to distant worlds. The spectroscope has far outstripped that instrument, by extending our powers of analysis to regions as remote.

Postal deliveries were and are great and able organisations, but what are they to the telegraph?

Need we try to extend our vision into futurity farther? Our present knowledge, compared to what is unknown even in physics, is infinitesimal. We may never discover a new force—yet, who can tell?

Earl Ducie proposed a vote of thanks to the President, which was seconded by Mr. Hodgson, M.P.

The Mayor of Bristol welcomed, on behalf of his fellow citizens, the British Association to Bristol. He trusted the members who had come there would have already seen that the city of Bristol duly appreciated the visit of the British Association. It was very true that forty years had elapsed since the British Association had been in Bristol; but he ventured to say, from the interest taken in this visit, no such period would elapse before they again saw the British Association. He had very great pleasure in putting to them the motion of a vote of thanks to their worthy President, Sir John Hawkshaw. They had already passed that vote by acclamation, and he put it to them formally.

The motion was carried, and the proceedings then terminated.

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At 1 o'clock on Wednesday a meeting of the General Committee was held in the Museum, Dr. CARPENTER presiding. The Report stated that the Resolution urging the Government of India to continue the solar observations in India had been submitted to the Government, and a reply had been received from Lord Salisbury intimating that an establishment would be employed at Roorkee during the year 1875-76 to take observations of the sun and of satellites. Another Resolution requesting the Government to undertake an Arctic Expedition had been complied with, and the Expedition had already been despatched. Invitations in regard to the holding of the meeting for 1877 have been received from Plymouth and Leeds. The usual formal resolutions for the appointment of officers for the meeting at Glasgow next year were adopted.

The number of tickets taken up to Thursday evening, by members and associates, was 2206.

A soirée, under the auspices of the Bristol and Bath Natural History Societies, was held in the Colston Hall last night, which was numerously attended. A large number of microscopes were exhibited.

The foreign visitors present at the meeting include M. Charles Buls, Brussels; Professor Léon Vanderkindere, University of Brussels; Dr. Alphons Oppenheim, Berlin; H. A. Rowland, Baltimore; Dr. James K. Patterson, Kentucky University; Dr. S. Nachtigal, Berlin; Chevalier Dr. G. W. Leitner, Lahore, India; M. Ch. Bergeron, C.E., Paris; Jas. J. Skinner, Ph.B., C.E., Yale College, New Haven; Dr. E. L. Youmans, New York.

SECTION B.
CHEMICAL SCIENCE.

President—Professor A. G. Vernon Harcourt, M.A., F.R.S.

Vice-Presidents—Professor Atkinson; Professor Debus, F.R.S.; Professor J. H. Gladstone, F.R.S.; Dr. Longstaff; Professor N. Story Maskelyne, F.R.S.; T. Proctor; Professor W. J. Russell, F.R.S.; Professor Williamson, F.R.S.

Secretaries—H. E. Armstrong, Ph.D.; W. Chandler Roberts, F.R.S.; William A. Tilden, D.Sc.

Committee—A. H. Allen; Professor J. Attfield; H. Bauerman; H. B. Brady, F.R.S.; W. Lant Carpenter, B.Sc.; M. Carteighe; Professor Corfield, M.D.; R. Calvert Clapham; W. W. Fisher; A. E. Fletcher; T. B. Groves; Professor Guthrie, F.R.S.; A. S. Hobson; Professor G. C. Foster; S. Lupton, M.A.; Professor McLeod; W. Weldon; P. J. Worsley, B.Sc.; T. Wills; G. F. Rodwell; G. F. Schacht; J. Smyth; W. W. Stoddart; Professor T. E. Thorpe; Charles Thomas.

The proceedings of this section were opened at eleven o'clock yesterday morning at Freemasons' Hall, by the reading of the President's address, which we shall publish *in extenso* in our next number.

Professor A. W. WILLIAMSON in eloquent terms proposed a vote of thanks to Professor Vernon Harccurt for his address, which was seconded by Professor J. Attfield.

Professor T. E. THORPE then read a Report of the Committee for the purpose of "Determining the Specific Volumes of Liquids."

Mr. W. CHANDLER ROBERTS, F.R.S., presented the Report of the Committee for the purpose of "Investigating the Methods of making Gold Assays, and stating the Results thereof."

The President, Professor A. VERNON HARCOURT, described an "Apparatus for Estimating Carbon Bisulphide in Coal Gas."

The reading of the following papers concluded the first meeting of the section:—"Some Account of the Manufacture and Refining of Sugar in Bristol, 1875," by Mr. Henry T. Chamberlain; "The Tobacco Trade of Bristol," by Mr. Thomas Davey; "A Simple Method of Determining the Proportion of Carbonic Acid in Air," by Mr. A. S. Davis.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 79.)

OZONE has never been obtained in a state of purity.

All chemical methods, as well as the electrolysis of water, yield it only very sparingly, since not merely reducing agents, but even oxidisers—all super-oxides for instance—re-convert ozone into ordinary oxygen. The example of barium super-oxide shows this in the following equation:—$O_3 + BaO_2 = 2O_2 + BaO$.

Connections of cork and caoutchouc cannot be used in an ozone apparatus, on account of their oxidisability. The electric spark has also a destructive action upon ozone. The best procedure for its preparation is, therefore, silent discharge with the aid of a Ruhmkorff's apparatus in induction-tubes, filled with oxygen. The greatest contraction which Andrews and Tait observed in oxygen thus treated was one-twelfth. This, as has been shown above, amounts to the transformation of one-fourth of the oxygen present into ozone.

An instrument of this kind, of a simple construction, was described by Werner Siemens† in 1857. Brodie‡ has recently defended the claims of this eminent physicist in opposition to supposed recent inventors, especially Houzeau. Wills‖ gave the instrument a less fragile form, and with this modification it has been recently introduced into trade by the English mechanicians, Tisley and Spiller.§ It has the advantage that it can be cooled by the passage of a current of water. As Siemens recommended the application of the thinnest possible glass it remains to be decided whether the more solid form may not involve a reduction of the yield of ozone.

Siemens's instrument consists essentially of two concentric tubes of glass, the inner tube being lined with tinfoil within, and the exterior coated with the same material without. The inner tube is closed at one end, and is sealed to the outer tube in such a manner that an interval remains between them. The outer tube is drawn out at one end to a thin junction piece, and a similar one is fused to it at the other end. Oxygen circulates in the interval. If the wire ends of the Ruhmkorff's apparatus are brought in contact with the tinfoil coating of the tubes, the intervening space becomes luminous, and the oxygen present is ozonized. Rumine¶ in England and Löw in France,** patented, in 1872, a process for obtaining ozone by blowing cold air into the Bunsen flame. There is no information as to the results of this process.

A patent obtained in England, and specified far from clearly, for obtaining ozone by boiling seaweed,†† may be mentioned as a curiosity, and also the credulity with which ozone-baths, prepared in this manner, find a ready sale, in spite of, or perhaps rather on account of, their high price. It appears at any rate that an industrial method of obtaining ozone is hitherto an unfulfilled desideratum.

(To be continued)

POTASSIUM CYANATE AND UREA.

By CHICHESTER A. BELL, M.B.

HAVING on several occasions lately been in want of small quantities of potassium cyanate, a salt not readily pro-

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."
† Siemens, *Pogg. Ann.*, cii., 120.
‡ Brodie, *Nature*, Feb. 18, 1874.
‖ Wills, *Ber. Chem. Ges.*, vi., 769.
§ *Nature*, viii. (1873), 148.
¶ Rumine, *Ber. Chem. Gesell.*, v., 123.
** Löw, *Ber. Chem. Gesell.*, v., 740.
†† *Berl. Chem. Gesell.*, v., 543.

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curable in the shops, the many inconveniences attending its preparation by the usual processes, as well as the varying quantities obtainable, induced me to seek for some more convenient and equally productive method. As the result of a few experiments in this direction, I venture to suggest the following modification of Liebig's well-known process, which will be found rapid and easy of execution, requiring no previous acquaintance with its details, and in the end economical both of time and material:—4 parts of perfectly dried and finely powdered potassium ferrocyanide are intimately mixed with 3 parts of dry and pulverised potassium bichromate. A small quantity of this mixture is placed in a porcelain or iron dish, the temperature of which is then raised until a tender-like combustion takes place, and the mixture blackens, which happens considerably below a red heat. The rest of the mixture is then thrown in by small portions at a time, each successive portion being allowed to blacken completely before it is covered by the next. This is necessary, inasmuch as if air be excluded during the combustion a considerable quantity of potassium cyanide will be found unoxidised. When all the mixture has been thus gradually added the lamp is removed and the dish allowed to cool completely. The result of the reaction, which occupies but a few minutes, even for a considerable quantity of material, is a porous friable mass, from which the cyanate may be extracted with the greatest ease in the usual manner by boiling alcohol. Methylated spirit which has been freed from a part of its water by standing over potassium carbonate, and rectified, answers the purpose admirably. In order to diminish as much as possible the loss from conversion of the cyanate into carbonate during boiling, and also to economise alcohol, it is advisable to add to the latter at each boiling only about as much of the mixture as can be thoroughly exhausted by it. The filtration takes place so rapidly that it is not necessary to employ a hot-water funnel, and the crystallisation of the cyanate may be hastened by immersing the vessel containing its alcoholic solution in cold water. The mother-liquor may be used an indefinite number of times in subsequent boilings. In a favourable experiment the resulting cyanate, equal to about 42 per cent of the dried ferrocyanide, contained less than 1 per cent of impurity.

To obtain the insoluble cyanates, lead, silver, &c., it is only necessary to exhaust the black mass with very cold water, to treat the filtered solution with barium nitrate, in order to remove the chromate and any unaltered ferrocyanide, and finally to precipitate with a nitrate of the metal.

From the above aqueous solution urea may obviously be prepared by the addition to it of 4½ parts of ammonium sulphate, evaporation to dryness, extraction with boiling alcohol, &c. Even from so small a quantity as one ounce of the dried ferrocyanide it is thus possible to obtain in a short time and with little trouble about 25 per cent pure urea. In this form the experiment would furnish a capital exercise for students.

I may here remark that for the purification of urea on the small scale, amylic alcohol will be found a much more convenient crystallising medium than ordinary alcohol.

Stevens's Hospital Laboratory, Dublin.

ESTIMATION OF MANGANESE IN SPIEGELEISEN, IRON, AND STEEL.

By SERGIUS KERN, St. Petersburg.

The methods now used for the estimation of manganese are very complicated, and in the hands of inexperienced analysts often give faulty results, even when the analyses are very carefully made. The method of precipitation of the manganese in the form of hydrated manganese dioxide ($3MnO_2H_2O$) by means of bromine, requires much labour, time (not less than 20—24 hours), and the work is very troublesome on account of the strong irritating smell of the bromine. In order to find out a better method I made numerous trials, and the following process for the estimation of manganese is, as I believe, a very easy method. Indeed, while analysing iron samples by my process, I found the percentage of manganese sometimes a little too high, but the incorrectness of the percentage was so small that it could have no influence in metallurgical operations. I destine my method especially for laboratories of iron and steel works, where analyses of such kind are frequent, and where a rapid estimation of manganese is necessary.

One gramme of the substance in the form of powder is dissolved in 30 cub. centim. of hydrochloric acid. The solution is heated during 30—40 minutes to allow the chemically combined carbon to fly away in the form of carburetted hydrogen; the liquor is evaporated to the half of the original solution, and water is then added. Silica (SiO_2) if it occurs in the substance is found as a precipitate; it is filtered from the solution, well washed, and the washing-waters are poured into the solution, to which is added an *excess* of hydrate of potassium (HKO). In this case the alumina (Al_2O_3) which may be found in the analysed sample remains in solution, and the hydrated ferrous and manganous oxides ($Fe(OH)_2$ and $Mn(OH)_2$) fall down in the form of precipitates. These oxides are separated from the liquor, washed, dried, and ignited over a strong fire in the presence of air: thus ferric oxide (Fe_2O_3) and mangano-manganic oxide (Mn_3O_4) are formed. This mixture, in the form of a powder, is introduced into a small hard glass tube, and heated by means of a spirit-lamp; whilst through the tube a current of pure hydrogen is passed. In about 15—20 minutes the operation is finished; the mass in the tube then commences to be greenish, owing to the formation of manganese monoxide (MnO), because, as it is known, the hydrogen reduces the iron-oxides into metallic state, but the manganese oxides only to the state of manganese monoxide. The reactions may be represented by the following equation—

$$Fe_2O_3+Mn_3O_4+8H=Fe_2+3MnO+4H_2O.$$

The tube is cooled and the hydrogen is all the time passed over the mass, as the reduced iron in a finely divided state takes fire when exposed to the air. When the tube is cold it is thrown into a metallic cup with pure naphtha oil. The oil before being used is boiled in order to free it from the dissolved oxygen of the air. If the remainder from the operation cannot be easily separated from the tube, the tube may be broken, and the residue is then carefully powered under the naphtha, and the iron is collected by means of a magnet. The remaining manganese oxide is washed and ignited in the presence of air; the substance turns brown with the formation of mangano-manganic oxide (Mn_3O_4). The Mn_3O_4 obtained is accurately weighed; knowing that mangano-manganic oxide contains 72·05 per cent of manganese it is not difficult to calculate the percentage of manganese in the analysed sample.

SOCIETY OF PUBLIC ANALYSTS.

REPORTS OF PUBLIC ANALYSTS.

Of a number of Quarterly Reports presented recently to their respective appointing bodies by various Public Analysts, we may notice the following:—

Dr. Tripe, Analyst for the Borough of Hackney, reports that during the last quarter he has examined, in all, 120 samples, including 31 samples of wine, spirits, and beer, which were obtained simply to ascertain the general quality, notice not being given to the vendors at the time of purchase.

The pickles analysed were found to be pure, except in one case, where turmeric had been added, but this was not reckoned as an adulteration.

Of 21 samples of milk, 2 had had water added, and more than half the total number had been skimmed. In spite

of this, however, the Analyst considers that the milk supply shows a "very decided improvement" as compared with last year.

Tea, coffee, sugar, bread, sweatmeats, lard, and pepper were all found to be unadulterated, and, although much of the tea was very inferior in quality, and though the coffee supplied to the inspector was pure, Dr. Tripe expresses a doubt whether the ordinary purchasers are so fortunate as to get it without chicory.

Of 9 samples of butter, one was found to be grossly adulterated with foreign fats.

Six samples of iodide of potassium were found to be pure.

The remaining samples of wines, spirits, and beer were of very low quality. The wines were all bad, and one sample of sherry "was merely a mixture of coarse spirit, sugar, colouring and flavouring matter."

Three samples of brandy were, respectively, 17, 30, and 40 under proof, and the poorest of them "gave as a distillate a coarse, fiery, offensive spirit without any brandy flavour whatever."

Four samples of gin varied between 37 and 47 under proof, and the samples of whiskey from 22 to 25 under proof. The rum examined was of fair quality.

The samples of porter had been reduced with water in proportions varying from 10 to 33 per cent, besides an excess of salt being, in one instance, present.

In four out of five of the samples, the bitter was not that of hops, and this applied also to some of the samples of ale, which were, however, on the whole, superior in quality to the porter.

Mr. Stoddart reports that, in the county of Somerset, the results of the food analysis for the last quarter show a "marked improvement." He has analysed, in all, 82 samples, of which 17 were adulterated, including samples of tea, coffee, mustard, and milk.

Dr. Stevenson reports that, in St. Pancras, he has examined 47 samples of various substances, all of which were pure except milk, 12 samples of which (out of a total of 29) were adulterated with water, the maximum quantity added being 30 per cent, besides which the cream had in several instances been removed.

Mr. Wigner reports that, in the three districts of Greenwich, Plumstead, and Woolwich, he has, during the last quarter, analysed 101 samples, of which 20 were adulterated. These comprised 17 of milk (out of 47 samples) and 3 of coffee (out of 8 samples). Mr. Wigner considers these results, on the whole, good, but points out that there appears to be no decrease in the practice of adulterating milk with water in the districts for which he acts.

NOTICES OF BOOKS.

A Manual of Dyeing and Dyeing Receipts. By JAMES NAPIER, F.R.S.E., F.C.S., &c. Third Edition. London: Charles Griffin and Co.

WHEN this work first appeared, some 20 years ago, it was simply a collection of dyeing receipts. In that state it enjoyed a considerable circulation, deriving an additional value from the fact that the author's practical experience had been obtained in the dye-works of western and south-western Scotland. It afforded, therefore, the means of comparing the procedures of Scotch dyers with the methods followed respectively in the Lancashire, Yorkshire, West of England, Leicester, and Coventry districts.

Since the date of its first issue, the art of dyeing has undergone a revolution almost equal to a re-creation. The introduction of the coal-tar products, and of other artificial colours, has gone far to render all earlier works on the art obsolete. We need not, therefore, feel surprised that the author has deemed it necessary to produce a new and a greatly-modified edition. In its present form it may be said to offer a systematic treatise on chemistry and physics from the point of view most likely to interest a dyer. Many substances are, of course, mentioned which have no direct or known bearing upon tinctorial operations. As, however, it is now felt to be desirable that the dyer should have a general acquaintance with chemistry, the notice of such bodies cannot be condemned as irrelevant. Those substances which figure daily in the operations of the dye-house are naturally described in detail. Next follows a chapter on mordants, considered both theoretically and practically, with receipts for the preparation of red spirits, barwood spirits, plum spirits, &c. It is remarkable that in another section of the work (p. 345) we find another and slightly different set of receipts for the very same compounds. If we turn back to p. 158, under the head "Tin," we find a third set of instructions for the preparation of dyer's spirits. It would have been better, surely, to have placed all these receipts together, and to have struck out all that are mere repetitions. From mordants, the author passes on to a description of vegetable colouring matters, the coal-tar dyes being added as an appendix. The distribution of space is certainly not in harmony with the relative importance of the subjects. Thus the coal-tar colours are described in thirteen pages, whilst Wongshy and Sooranjee which are mere curiosities occupy each nearly one-third of that space.

Turmeric is mentioned as a substance "formerly used in dyeing." As lately as 1870 it was certainly in use on a very large scale among stuff-dyers in the Bradford trade for the production of certain compound shades, especially so-called "sour browns," and for dyeing the cotton of mixed figured goods, producing, *e.g.*, a gold-coloured design on a scarlet or blue ground.

Archil, we are told, is prepared as follows:—"The lichens are first ground between two stones to a pulp, with the addition of water, and afterwards put into a wooden trough having a tightly-fitting cover; upon the moist pulp is sprinkled a mixture of urine and ammonia, and the vessel being then covered, fermentation soon begins. About six weeks are required to complete the operation." We do not desire to find any unnecessary fault; but we cannot help saying that such instructions are not of the slightest value.

The next section of the book consists of dyeing receipts, preceded by "preliminary preparations for dyeing." Some of these are curiously useless. No dyer, certainly, will waste his time in making copperas, or blue vitriol, since he can procure them from the drysalter at a much cheaper rate. Caustic soda is now also a regular article of commerce, and caustic potash has scarcely any applications in dye-works. Nitrate of iron is described in three several parts of the work (pp. 136, 198, and 342). But in all these passages it is spoken of as obtained by the action of nitric acid upon metallic iron. Now at least 9-10ths of the liquid used as nitrate of iron is more correctly a nitro-sulphate, and is made by treating copperas with proportions of nitric acid, varying greatly in different establishments. Nor is there any reference—as far as we have been able to discover—to the different qualities of nitrate of iron required for blacks, for royal blues, and for "saddening" compound colours.

Among the dyeing receipts for cottons, we find no mention of madder reds, nor, of any shades produced with artificial alizarine. To produce a scarlet upon woollens, we are told to "work for an hour in a bath, to which has been added 1lb. tartar, 2ozs. dry cochineal, 8ozs. sumach, 8ozs. fustic." We never saw a cochineal scarlet produced in practice without the use of some preparation of tin; nor have we met with any other receipt in which this important requisite was omitted. The dyeing of mixed fabrics has not received a share of attention at all commensurate with its importance. There are three receipts for producing two colours on a piece, and five for dyeing the whole one colour. The author remarks that "the operator, by a careful study of the different modes of dyeing the different fabrics, may easily dye any mixed fabric one or more colours." We can assure him

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that this problem, which he thinks so easy, occupied the attention of the stuff-dyers of Bradford for some 20 years, and involved numerous and costly failures before being brought to its present perfection.

At the end of the book we find a "glossary of technical terms used in the dye-house." Such a glossary, comprising the technical terms and trade names common in different districts, with their scientific equivalents, would be extremely valuable. But our author is not always fortunate in his explanations. Thus under "double muriate" we read "a saturated solution of *bichloride* of tin," and under "single muriate," "half strength of double *perchloride* of tin." It is, of course, well known that bichloride and perchloride of tin were till lately the authorised names for the bodies now known as stannic chloride, or tin tetrachloride. But if we turn to pp. 344 and 346, we find these mordants quite correctly described as being *proto* chloride of tin, now called stannous chloride or dichloride. Which of these two contradictory views is the reader, if inexperienced, to adopt?

That the work contains much valuable matter we gladly admit, and regret the more the presence of the defects and errors which we have been compelled to point out.

CORRESPONDENCE.

ADULTERATION OF BEER.

To the Editor of the Chemical News.

Sir,—As disputed cases of Public Analysts under the new Act will have to be referred to Somerset House, the result of the first reference of such a kind, so far as I am aware, may be interesting to some of your readers.

Some time ago, I gave a certificate of a beer being slightly adulterated by containing a small excess of common salt. The case was defended by the brewers (a Manchester firm). An adjournment was asked for, with the desire that the remaining portion of the sample should be submitted to Somerset House. This wish was complied with; the sample was despatched, and in due course the Somerset House authorities reported that it contained 58·20 grs. of salt per gallon, as against 59·05 grs., the amount given on my certificate—of course, to me, a very satisfactory result. The case has since been withdrawn, as explained by the enclosed cutting from the *Midland Counties Express* of the 14th inst. —I am, &c.,

E. W. T. Jones,
Public Analyst for South Staffordshire and the Borough of Wolverhampton.

Public Analysts' Laboratory,
10, Victoria Street, Wolverhampton,
August 17, 1875.

"The New Adulteration Act.—Mr. Underhill brought under the notice of the learned Stipendiary (J. Spooner, Esq.) a case which was heard some weeks ago at Wednesbury, involving a charge against a publican named Shaw, living at Great Bridge, of selling adulterated ale. The certificate of the county analyst, he said, was to the effect that the ale contained nearly 59 grains of salt to the gallon; and the analyst at Somerset House, to whom a sample had been sent for inspection, gave practically the same figures as Mr. Jones. The brewers, who were really defending the case, were desirous of having the question judiciously settled as to whether a hard and fast line must be drawn at 50 grains to the gallon, but a new Act of Parliament affecting the point would come into operation on the 1st of October next, and any decision which was arrived at now might be altered at that time. He had, therefore, had a conversation with Mr. Horder, the inspector under the Adulteration Act, and suggested to him that the ends of justice would be met by the withdrawal of the case on the defendant paying all the costs.—Mr. Horder remarked that under the circumstances he did not object to a withdrawal, as the defendant had been subjected to very heavy expenses.—The learned Stipendiary said the only reason why he hesitated at all in the matter was that he had convicted other persons for a no greater amount of adulteration. Considering the costs of the defendant, which had been further increased by an appearance at Wednesbury Police Court last week, when he (Mr. Spooner) was too ill to attend, and also looking at the fact that an Act of Parliament affecting the question, which he had not at present seen, would soon become law, he did not see the unfairness of allowing the case to be withdrawn.—Summons withdrawn accordingly."

MR. ALLEN "ON BUTTER."

To the Editor of the Chemical News.

Sir,—Mr. Allen's paper, published in the Chemical News, vol. xxxii., p. 77, is calculated to convey an incorrect impression as to the actual condition of butter analysis.

The difficulty of distinguishing between butter-fat and other fat of like melting-point has not yet been surmounted, and I am afraid that the so-called detections of that kind of adulteration must rank with the old-fashioned alum detection.—I am, &c.,

J. Alfred Wanklyn.

Laboratory, 117, Charlotte Street, Fitzroy Square,
London, W., August 21, 1875.

THE DETECTION OF NICKEL AND COBALT.

To the Editor of the Chemical News.

Sir,—In the Chemical News, vol. xxxii., p. 71, Mr. A. P. Luff mentions his belief that in my paper on the above subject (vol. xxxii., p. 44) I have taken more credit than I am fairly entitled to.

As the paper in question contains what may be called two methods, as well as an additional test for the identification of nickel, Mr. Luff might have indicated more exactly to what extent, in his opinion, Messrs. Compton and Gostling were entitled to credit.

I have not heard of anyone using ferrocyanide for the detection of cobalt; I suppose, therefore, the method first detailed is that to which Mr. Luff more especially refers.

In this belief, I must trespass upon your valuable space in stating the facts of the case, as far as I remember them. And, first, I would observe that the phrase "as far as I remember them" is inserted because the occurrence took place some eighteen months ago, I suppose; and after this lapse of time it is difficult to speak with absolute certainty upon such a question. (Mr. Luff is in error when he says that either he or the two gentlemen he mentions studied in the laboratory of the Pharmaceutical Society *last session*. They all worked there during the session before last.)

In January or February, 1874, Mr. Compton showed me the red-coloured liquid he had accidentally obtained by adding ferricyanide of potassium to ammoniacal solution of a cobalt salt. I had not at that time seen the papers on the subject by Messrs. Skey and Allen, and thought that, in thus finding cobalt ferricyanide soluble in ammoniacal salt, he had made an original discovery. I went over the matter at his bench, and within an hour found that, by employing ferrocyanide and partially neutralising the solution, nickel might be identified when occurring either with or without cobalt.

Mr. Compton and Mr. Gostling have been asked by me what portion of the test each considers himself to have discovered. Mr. Compton replies that, as far as he recollects, the account given above is correct in its details. Mr. Gostling, on the other hand, writes as follows (letter received this morning):—"I am certain that the idea of using potassium *ferro*cyanide for nickel was mine; as to the gradual addition of an acid, I firmly believe that was mine also."

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Mr. Gostling may have found out how to advantageously employ ferrocyanide for nickel; I have no reason for asserting that he did not. Indeed, it seems to me that any man with good common sense, understanding the significance of the statement that potassic ferricyanide reacted, under certain circumstances, in a marked manner with cobalt salts, would probably try what effect this reagent had upon nickel salts, and also what effect ferrocyanide had upon salts of both metals similarly circumstanced.

Mr. Gostling's opinion, I need hardly say, does not shake my belief (which Mr. Compton appears to share) that this essential feature of the method was discovered by me.—I am, &c.,

R. H. DAVIES.

Newport, Mon., August 21, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, tome lxxxi., No. 5, August 2, 1875.

Magnets Formed with Compressed Powders.—M. J. Jamin.—De Haldat published in 1836, in the *Mémoires de l'Académie de Stanislas*, an interesting observation. He placed iron filings in a brass tube with screw stoppers; magnetised it by ordinary means, and found that it had acquired and preserved at its extremities two contrary poles. The polarity did not augment sensibly when the stoppers were tightened; it only diminished slowly when increasing quantities of sand were mixed with the filings. In all cases the polarity was feeble, and disappeared on shaking the tube. M. Jamin has repeated the observation, compressing the filings strongly by means of a small hydraulic press. The polarity increases with the pressure. Filings were prepared under the author's eyes from very soft iron, perfectly reduced, and free from coercitive force. The results did not diminish. Here, therefore, is a metal which has no coercitive force when it is continuous, but which acquires a force as considerable as that of steel if reduced to discontinuous fragments, and aggregated by pressure. Is it not to this discontinuity that the force observed must be ascribed, and is it not this same cause which explains the coercitive force of steel? If the filings before pressure are mixed with matters which render the mass more homogeneous, the same degree of polarity is no longer produced. For instance, on making a paste of chloride of iron and iron filings, and pressing it, we obtain after some days a subchloride of iron of continuous appearance, which may be filed and polished like pure iron, but which scarcely becomes magnetic.

Purchase of Beet-Root based upon the Density of the Juice.—M. Durin.—It has been shown that the quality of beet-root is in an inverse ratio to the bulk of the crop. The interests of the grower who expends azotised manures in order to obtain an abundant crop are opposed to those of the manufacturer who wishes to operate upon a rich article only. It is clear that as long as beets are bought by weight these opposite interests cannot be reconciled. It is therefore proposed to fix the value of the roots in accordance with the density of the juice.

Microzymas, and their Functions in Different Ages of the Same Animal.—M. J. Béchamp.—A valuable physiological paper.

New Procedure for the Determination of Free Oxygen in Urine.—M. D. Freire.—The author employs pyrogallic acid dissolved in an excess of ammonia. Of this acid 0·002 grm. absorb 0·52 c.c. of oxygen. He makes a standard solution with this quantity of pyrogallic acid dissolved in an excess of ammonia, which is exposed for some time to the air in order to saturate it with oxygen. He then makes a solution of 1·4 grms. stannous chloride in 100 c.c. hydrochloric acid moderately concentrated, and fills a graduated burette with this liquid. It is allowed to flow drop by drop into that resulting from the contact of the pyrogallic acid and ammonia until completely decolourised. The number of degrees of the burette required for this purpose corresponds to the real quantity of oxygen absorbed by 0·002 grm. of pyrogallic acid. This done, he takes 50 c.c. of urine, adds 0·002 gr. of pyrogallic acid, after dilution with distilled water recently boiled, so as to have a colourless liquid, and it is then covered with a layer of pure essence of turpentine, several centimetres in depth. An excess of ammonia is then added, letting it flow in along the side of the vessel. The liquid which was colourless becomes gradually violet or yellowish, a change due to the absorption of the small amount of oxygen. The (stannous) liquor is then added with the burette, drop by drop, until it is decolourised. The number of divisions necessary for decolourisation gives the amount of oxygen.

Molecular Combinations.—M. C. Friedel.—Reserved for insertion in full.

Complete Separation of Arsenic from Animal Matters, and on its Determination in Various Tissues.—M. Armand Gautier.—The author's method agrees very closely with that of Dr. Scolosuboff.

Determination of Glucose in Wine; a reply to a Reclamation by M. Chancel concerning the apparently Gummy Matter of Wine.*—M. A. Béchamp.—A controversial paper.

Les Mondes, Revue Hebdomadaire des Sciences, No. 13, July 29, 1875.

The editor gives in this number, under the curious heading *Chronique Philosophique*, seven pages of a denunciation of M. Littré on the occasion of his having become a Freemason. There is no chemical or physical matter.

M. Reimann's Farber Zeitung, No. 27, 1875.

The shoemaker at Stettin, said to have been poisoned by the dye of the lining of his hat, is found to have been merely suffering in consequence of an excessive dose of alcohol. The hat lining contained nothing poisonous.

There are receipts for a lilac and black on calico; a marine blue on mixed garments; a black, a brown, and a bismarck for woollen printing; a mode grey and a fine orange for cotton yarns; and a black for horsehair.

No. 28, 1875.

This issue contains instructions for a black on horsehair; for a brown on mixed garments; a fast blue for woollen yarns and pieces, an olive for the same materials; and a cheap wood-red for wool. There are further receipts for a black (mill-fast) for cottons, and a corinth for cotton yarn.

No. 29, 1875.

This issue announces that in Lyon a kind of cloth is now prepared from the down of hens, ducks, &c. 750 grms. of feathers yield 1 square metre of a light and very warm fabric, which is waterproof, and admits of being dyed in all shades.

There are, further, receipts for brown and blacks on garments; for a fast and fugitive bismark on woollen yarn and cloth, and for a mulberry.

No. 30, 1875.

This issue contains calculations made by the firm of Simonis in Vervier, from actual work, showing that the

* *Comptes Rendus des Séances de l'Academie des Sciences*, lxxi., page 46.

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direct saving effected by the hydrosulphite-vat of Schützenberger and de Lalande as compared with the old fermentation-vat is 2 per cent on the net profit.

There are receipts for a light reseda on linen, a black on mixed garments, a rose on silk, and an iron-grey on silk yarns.

Bulletin de la Societe Chimique de Paris, No. 3, August 5, 1875.

Distribution of an Acid among several Bases Existing in Solution.—M. Berthelot.—Already noticed.

Direct Union of Propylen with the Hydracids.—M. Berthelot.—The author recommends as a lecture experiment to fill two stoppered bottles, the one with pure dry propylen, and the other with hydriodic acid gas, to bring them quickly in conjunction, removing the stoppers, and connecting the necks with a broad band of caoutchouc.

Acetates of Ammonia.—M. Berthelot.—The author has obtained an acid acetate,—

$$3C_4H_4O_4,2(C_4H_4O_4,NH)_3H_2O_2,$$

crystallising in long, brilliant, flattened needles, by dissolving the acetate of ammonia of commerce in its own weight of glacial acetic acid.

MISCELLANEOUS.

University of London (First M.B. Examination).—*Examination for Honours.*—Organic Chemistry, and Materia Medica and Pharmaceutical Chemistry. First class. Arthur Thomas Wilkinson (Exhibition and Gold Medal), Owens College School of Medicine; George Courtenay Henderson. (Gold Medal), University College. Second class. Francis Goodchild, St. George's Hospital. Third class. Richard Shalders Miller, University College.

NOTES AND QUERIES.

Action of Carbonic Acid on the Growth of Plants.—Dr. Daubeny made some experiments, I believe, on the growth of plants in an atmosphere containing more carbonic acid gas than air contains. I should be glad to be informed where I can find an account of these experiments, or what results were obtained.—C. O. Two.

TO CORRESPONDENTS.

J. De Baskerville.—We think you can purchase precipitated chalk more advantageously than you can make it. The best article is made by letting lime-water stand in a closed vessel till perfectly clear (to get rid of any suspended grit), and then running the clear liquid into an open vessel and passing into it carbonic acid gas, obtained by the action of dilute sulphuric acid upon ground limestone. The vessel must be covered with a cloth, to exclude dust, grit, &c.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 823.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BRISTOL MEETING, 1875.

ADDRESS TO THE CHEMICAL SECTION

BY

A. G. VERNON HARCOURT, M.A., F.R.S., F.C.S.,
President of the Section.

To the privilege of presiding over this Section custom has added the duty of offering some preliminary remarks upon the branch of science for whose advancement we are met.

In discharge of this duty some of my predecessors have reviewed the progress of chemistry during the previous year; and until a few years ago there was no more needful service that your President could render, though the task of selection and abstraction was one of ever-increasing difficulty. But a few years ago the wisdom and energy of Dr. Williamson transformed the *Journal of the Chemical Society* into a complete record of chemical research, and this Association materially promoted the advancement of science when it helped the Chemical Society in an undertaking which seemed at one time hopelessly beyond its means. The excellent abstracts contributed to the *Journal* err, if at all, on the side of brevity, and yet the yearly volume seems to defy the bookbinder's press. I shall not venture to attempt further abstraction, nor to put before you in any way so vast and miscellaneous an aggregate of facts as the yearly increment of chemistry has become. The advancement of our science—to borrow again the well-chosen language of the founders of this Association—is of two kinds. The first consists in the discovery and co-ordination of new facts; the second in the diffusion of existing knowledge, and the creation of an interest in the objects and methods and results of scientific research. For the advance of science is not to be measured only by the annual growth of a scientific library, but by the living interest it excites and the number and ardour of its votaries. The remarks I have to offer you relate to the advancement of chemistry in both aspects.

One fact has been brought into unpleasant prominence by the *Journal of the Chemical Society* in its present form, namely, the small proportion of original work in Chemistry which is done in Great Britain. All who are ambitious that our country should bear a prominent part in contributing to the common stock of knowledge, and all who know the effect upon individual character and happiness of the habit and occupation of scientific inquiry, must regret our backwardness in this respect. The immediate cause is easily found. It is not that English workers are less inventive or industrious than their fellows across the Channel, but that their number is exceedingly small. How comes it that, in a country which abounds in rich and leisurely men and women—for neither the reason of the case, nor the jealousy of the dominant sex, nor partial legislation, excludes women from sharing this pursuit with men—there are so few who seek the excitement and delights of chemical inquiry. Moralists tell us that the reason why some men are content with the pleasures of eating and drinking and the like is, that they have never had experience of the greater pleasure which the exercise of the intelligence affords. I am not about to represent it as the moral duty of those who have means and leisure to cultivate chemistry or any branch of science; but no taste for a pursuit can be developed in the absence of any knowledge of its nature. A taste for chemistry is often spoken of as a peculiar bias with which certain men are born. No doubt there are differences in natural aptitudes and tastes, but the chief reason why it is so rare for men of leisure to addict themselves to scientific pursuits is, that so few boys and young men have had experience of the pleasure which they bring. Much has been done during the last twenty years, both at the universities and at the public schools, to provide for the teaching of science. To speak of what I know best, the University of Oxford has made liberal provision for the teaching of science, and for its recognition among the studies requisite for a degree; nor have the several colleges been backward in allotting scholarships and fellowships as soon as and whenever they had reason to believe that those elected for proficiency in science would be men equal in intellectual calibre to those elected for proficiency in classics or mathematics. But the result is somewhat disappointing, and under a free-trade system science has failed to attract more than a small percentage of University students. Excellent lectures are delivered by the Professors to scanty audiences, and the great bulk of those educated at the University receive no more tincture of science than their predecessors did twenty ago.

The recognition of science among the subjects of University examinations is by no means an unmixed advantage to those concerned. Examinations have played and will continue to play a useful part in directing and stimulating study, and in securing the distribution of rewards according to merit; but they produce in the student, as has often been pointed out, a habit of looking to success in examination as the end of his studies. This habit of mind is peculiarly alien to the true spirit of scientific work. Only such knowledge is valued as is likely to be producible at the appointed time. Whether a theory is consistent or true is immaterial, provided it is *probable*, that is to say, advanced by some author whose authority an examiner would recognise. All incidental observations and experimental inquiry lying outside the regular laboratory course, which are the natural beginnings of original work, must be eschewed as trespassing on the time needed for preparation. The examination comes; the University career is at an end; and the student departs, perhaps with a considerable knowledge of scientific facts and theories, but without having experienced the pleasure, still so easily gained in our young science of chemistry, of adding one new fact to the pile of knowledge, and, it may be, with little more inclination to engage in such pursuit than have most of his contemporaries to continue the study of Aristotle or Livy.

However, examinations have their strong side, to which I have referred, as well as their weak side; and, although it is the natural desire of a teacher to see his more promising pupils contributing to the science with whose principles and methods they have laboured to become acquainted, the younger, like the elder branches of knowledge, must be content to serve as instruments for developing men's minds. Chemistry can only claim a place in general education if its study serves, not to make men chemists, but to help in making them intelligent and well informed. If it is found to serve this purpose well, the number of chemical students ought to increase; and if the number increases, no rigour of the examination system will prevent one or two, perhaps, in every year adopting chemistry as the pursuit of their lives. But the Universities have little power to determine what number of students shall follow any particular line of study. With certain reserves in favour of classics and mathematics, their system is that of free-trade. Young men of eighteen or nineteen have tastes already formed, some for the studies which were put before them at school, in which, perhaps, they are already proficient and have been already successful, some for games and good-fellowship. It is from the nature of the case with the masters of schools that the responsibility rests of fixing the position of science in education. During the last ten years provision has been made at most of the larger schools for the teaching of some branches of science;

and those who recall the conservatism of schoolboys, and their consequent prejudice in favour of the older studies, will understand a part of the difficulties which have had to be encountered. The main and insurmountable difficulty is what I may call the impenetrability of studies. A new subject cannot be brought in without displacing in part those to which the school-hours have been allotted. It is the same difficulty which occurs again and again in human life. There are so many things which it would be well to know and well to follow; but life, like school-time, is too short for all. From the educational phase of this difficulty the natural differences of tastes and aptitudes provide in some degree a way of escape. I think that, wherever a school can afford appliances for the teaching of chemistry, all the boys should pass through the hands of the teacher of this subject. Two or three hours a week during one school-year would be sufficient to enable the teacher to judge what pupils were most promising. There may be instances to the contrary, but I do not think it likely that any boy who attended chemical lectures for a year without becoming interested in the subject would ever pursue it afterwards with success. Suppose that, out of one hundred boys who have gone through this course, five are selected as having shown more intelligence or interest than the rest; they should be permitted to give a considerable part of their time, while still at school, to studying science without suffering loss of position in the school, or forfeiting the chance of scholarship or prizes. If any such system is possible, and were generally adopted, each school sending annually to the Universities, or other institutions for the education of young men, its small contribution of scientific students, the Professor's lecture-rooms and laboratories would be filled with young men who had already learnt the rudiments of science. Laboratories of research as well as of elementary instruction would find a place at the English Universities, and the reproach of barrenness would be rolled away.

Some of the defects or difficulties to which I have adverted are perhaps peculiar to our older schools and universities. The introduction of the study of natural science has borne earlier fruit in schools whose celebrity is of more recent date, such as the excellent College in this neighbourhood. Oxford and Cambridge ought to possess, but are far from possessing, such laboratories as have lately been built at the Owens College, Manchester. It is proposed to constitute in this city a College of Science and Literature, similar to Owens College and in connection with two of the Oxford Colleges. The scheme set forth by its promoters appears thoroughly wise and well considered, and all who are interested in scientific education must wish it success.

I have placed first among the modes in which science—and in particular chemical science—may be advanced the assignment to it of a more prominent and honoured place in education; but owing, as I do, my scientific calling and opportunities of work to a bequest made to Christ Church by Dr. Matthew Lee more than one hundred years ago, I cannot forget or disbelieve in the influence of endowments.

I have spoken of the leisurely class in this country as that to which scientific Chemistry must look for its votaries. In our social conditions, and in the absence of endowments, it is hard to see where else they can be found. Men who have their livelihood to make cannot afford to spend money, and still less to bestow their time and energy on the luxury of scientific inquiry. Even if they have the opportunity of earning their livelihood by scientific teaching no leisure may remain to them for original work, and the impulse to such work (often, it must be admitted, of a feeble constitution) is starved in the midst of plenty. The application of endowments to the promotion of original research is a difficult question. I am inclined to think that posts, constituted chiefly with this object, should be attached in every case to some educational body, and should have light educational duties assigned to them. The multiplication of such posts in connection with the many colleges and schools in this country, where there is some small demand for chemical teaching, with the provision in each case of a sufficient laboratory and means of work, would probably do more than any centralised scheme for the promotion of chemical research.

To the advancement of chemistry by the formation of public opinion on the questions of scientific education and the endowment of original research, the Chemical Section of the British Association may reasonably hope to contribute. But doubts have been expressed as to the serviceableness of this or any such organisation for the direct advancement of our science itself. No doubt we cannot accomplish much. Chemical inquirers at the present time may be compared to a party of children picking wild flowers in a large field; at first all were near together, but as they advanced they separated, till now they are widely scattered, singly, or in groups, each busy upon some little spot, while for every flower that is gathered ten thousand others remain untouched.

That the science of chemistry would advance more rapidly if it were possible to organise chemists into working parties, having each a definite region to explore, cannot, I think, be doubted. Is such organisation in any degree possible?

The experiments of which Bacon has left a record, though curious historically, have no scientific value. But in one respect his "Physiological Remains" furnish an example which we might follow with profit. "Furthermore," he writes, "we propose *wishes* of such things as are hitherto only desired and not had, together with those things which border on them, for the exciting the industry of man's mind." I will quote further, as an example, a part of one of his wishes, which has very recently been fulfilled. "Upon glass four things would be put in proof. The first, means to make the glass more crystalline. The second, to make it more strong for falls and for fire, though it come not to the degree to be malleable."

I do not know that the industry of M. de la Bastie's mind was excited by Bacon's enumeration of glass more strong for falls and for fire among things hitherto only desired and not had; but the conception of such an enumeration seems to me worthy of its author. Much fruitless and discouraging labour might be saved, a stimulus might be given to experimental inquiry, and chemical research might become more systematic, and thus more productive, if Bacon's example were followed by the leaders of chemistry at the present day.

The Council of the Pharmaceutical Conference, whose meeting has just preceded our own, has published a list of subjects for research which they commend to the attention of chemists. Where one of these subjects has been undertaken by any chemist his name is appended to it. Might not the representatives of scientific chemistry issue a similar list?

Perhaps two or three of the distinguished English chemists who are members of this Association, might be willing to serve on a committee, which should put itself into communication with the leaders of chemical inquiry abroad, and should make and obtain and publish suggestions of subjects for research. Such a list so got together would, I think, find a welcome place in all scientific journals, and would thus be widely known and easily accessible to every student.

That which chiefly makes the organisation of chemical inquiry desirable is the boundless extent of the field upon which we have entered. Not every fact, however laboriously attained and rigorously proved, is an important fact in chemistry any more than in other branches of knowledge. Our aim is to discover the laws which govern the transformations of matter, and we are occupied in amassing a vast collection of receipts for the preparation of different substances and facts, as to their composition and properties, which may be of no more service to the generalisations of the science, whenever our Newton arises, than were, I conceive, the bulk of the stars to the conception of gravitation.

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It may, however, be urged that the growth of chemical theory keeps pace with the accumulation of chemical facts. It is so, if the elaboration of constitutional formulæ is leading us up to such a theory. But at present, however useful and ingenious this mode of summarising chemical facts may be, it does not amount to a theory of chemistry.

Two objections to regarding such formulæ as anything more than a chemical shorthand, as it has been termed, seem worth recalling. The first is mentioned at the outset in most text-books in which these formulæ are employed, but sometimes, I venture to think, lost sight of afterwards. The arrangement of the atoms of a molecule in one plane is equally convenient in diagrams, and improbable as a natural fact. But is not this arrangement used as though it were a natural fact when the possible number of isomeric bodies is inferred from the number of different groupings of the atoms which can be effected on a plane surface? The conceptions of plane geometry are much simpler than those of solid geometry (which is another recommendation of the present system of formulæ); but so far as I am able to follow the similar theories which have recently been propounded independently by MM. De Bel and Van't Hoff, the consideration of the possible immersions of *solid* molecules leads to new conclusions. Wislicenus has found that paralactic acid undergoes the same transformations as ordinary lactic acid when heated and when oxidised. The two acids differ in their action on polarised light. His conclusion is that paralactic acid does not differ in its atomic structure from the lactic acid of fermentation, and that the kind of isomerism which exists between the two acids is not connected with the difference in the reciprocal arrangement of the atoms, but rather with a difference in the geometric structure of the molecule. To this difference he gives the name of "geometric isomerism." The authors named above agree in supposing that the action of substances in solution on polarised light results from an unsymmetrical arrangement of atoms and radicles in three dimensions around a nucleus atom of carbon.

The second objection relates to the statical character of the account which "developed" formulæ give of the differences between different kinds of matter. The modern theory of heat supposes, not only that the molecules which constitute any portion of matter are in constant rapid motion, but that the atoms which constitute each molecule are similarly moving to and fro. Such movement might be an oscillation about the position assigned to the several atoms in the constitutional formulæ of the molecule. Since, however, the modes of formation and decomposition of substances are the only facts upon which the formulæ are based, it is to be considered whether these facts may not depend altogether upon the nature or average nature of the motion impressed upon the atoms,—that is, upon dynamical and not upon statical differences.

Many substances are known whose existence is contrary to the theory of valency and saturation, such as nitric oxide and carbonic oxide; others, which transgress the theory of isomerism, such as chloride of dichlordibromethane ($C_2Cl_2Br_2,Cl_2$) and bromide of tetrachlorethane (C_2Cl_4,Br_2), which should be identical, but are isomeric; yet these theories are simply an expression of the statement that certain substances can exist or can differ, while others cannot. It is true that in the vast majority of cases the theoretical limitation appears to exist. But just as the absence of any fossil remains of the connecting links between species is only significant if the geologic search has been sufficiently thorough, so it is with chemical theories depending upon the non-existence of certain classes of bodies. Indeed, in our case, where investigation is guided by theory, and, as a rule, only those things which are looked for are found, the limitation may be partly of our own making. A chemist who should depart from the general course, and set himself to prepare substances whose existence is not indicated by theory, would perhaps obtain results of more than the usual interest.

Among chemical inquiries, if ever such a list as I have ventured to suggest should be drawn out, I hope that many would be included relating to the most peculiar substances and the simplest cases of chemical change. The thorough study of a few reactions might perhaps bring in more knowledge of the laws of chemistry than the preparation of many new substances.

I believe that if any chemist not content with a process giving a good yield of some product examines minutely the nature of the reaction, observing its course as well as its final result, he will find much more for study than the chemical equation represents. He will probably also find that the reaction and its conditions are of a formidable complexity, and will be driven back towards the beginnings of chemistry for cases sufficiently simple for profitable study.

In concluding my remarks, I desire briefly to refer to another branch of chemical science to the advancement of which this Association seeks to contribute—I mean applied or technical chemistry. One of the principal differences between the papers read before this Section, as a class, and those which the Chemical Society receives, is the larger proportion in our list of papers on technical subjects. Whatever chemists may hold, there can be no doubt that the estimation of our science by the outside world rests largely on the well-founded belief that chemistry is useful. Indeed, though scientific chemists are justly eager to vindicate the value of investigations remote from any application to the arts, they cannot but feel a livelier sense of triumph when the successful synthesis of a vegetable principle yields also a product of great technical value in the arts, as in the case of the production of artificial alizarin.

By visiting in turn the principal centres of British industry, this Association brings together men engaged on pure and on applied chemistry. We who come as visitors may hope that our papers and discussions here may bring fresh interest in the science, if not actual hints for practice, to those whose art or manufacture is based on chemistry. In return, the most interesting communications the Section has received have not unfrequently been the descriptions of local industries; and there is no part of our hospitable reception more welcome and more instructive to us than the opportunities which are provided of seeing chemical transformations on a large scale, and effected by processes which observation and inventiveness have gradually brought to perfection, and with the surprising familiarity and skill which are engendered by daily use.

ON MOLECULAR COMBINATIONS.

By M. C. FRIEDEL.

In a recent communication, I had the honour of calling the attention of the Academy to a compound of methylic oxide and of hydrochloric acid.* The properties of this compound appear to me particularly interesting, because it is one of that numerous class of compounds known as molecular. M. Kekulé has thus designated those which do not obey the generally admitted laws of atomicity. Formed by the union of two or more complete molecules capable of existing separately, they seem still to contain these molecules *as such*. They are instable and easily split up, especially under the influence of heat. Their non-existence in the state of vapour has been pointed out as their true characteristic. The facts which I have brought forward prove that this character is not absolute, and that there exist molecular compounds which may be vapourised without total decomposition. There is, then, no well-marked limit between atomic compounds and molecular compounds;

* Chemical News, vol. xxxii., p. 83.

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the one and the other may be re-united under one, and the same general law of combination. It would be illogical to ascribe the former to a cause residing in atoms, and the latter to a different cause inherent in molecules. The ultimate particles, whose existence the atomic hypothesis admits, should contain in themselves, as form or as motion, that which gives rise to all the phenomena produced by the aggregation of atoms, similar or dissimilar.

For chemists who, like M. Kekulé, admit for each element an absolute and invariable atomicity, there is here a difficulty which appears insurmountable, and which might make us forget the services rendered to the systematisation of chemical combinations by the consideration of atomicity. But if we, with Couper and Würtz, regard atomicity, *i.e.*, the capacity of saturation of the atoms, as varying at once with temperature and with the nature of the atoms brought in presence, the difficulty disappears. It becomes natural to ascribe the formation of the so-called molecular compounds to the existence, in certain elements, of supplementary atomicities, which only act at low temperatures. It may be difficult to determine these supplementary atomicities in a manner which shall not be arbitrary, but, by bestowing upon the study of molecular combinations, the same attention which has been hitherto given to atomic compounds, and by taking advantage of the analogies existing between the divers members of one and the same family, there is room to hope for ultimate success.

As to the compound which has been the starting-point of these investigations, C_2H_6O,HCl, it results that we may, without too great risk, ascribe its formation to two supplementary atomicities of oxygen, and, perhaps, at the same time, to two supplementary atomicities of chlorine. We know already bodies which oblige us to admit that oxygen sometimes acts as a tetratomic element; these are the quadrantoxides of H. Rose (Ag_4O,Cu_2O). We find another reason in the comparison of the hydrochlorate of methylic oxide with the interesting compound discovered by M. Cahours, obtained by the action of methylic iodide upon methylic sulphide. In this body, relatively stable (although decomposed if we attempt to convert it into vapour) and susceptible of double decomposition, the sulphur acts evidently tetratomically. It forms the link between the two molecules of sulphide of methyl and of iodide. Analogy leads us to believe that oxygen plays a like part in the combination of methylic oxide and hydrochloric acid. A negative experiment which I have made seems also to support this supposition. If we pass into a vessel cooled down to $-18°$ to $-20°$ a mixture of methylic chloride and hydrochloric acid, no liquid is condensed. Nor is there any contraction if we mix over mercury known volumes of hydrochloric acid and of methylic chloride. The sole difference between these experiments and those which gave rise to the compound in question is the presence of oxygen in the latter in place of chlorine.

The same supposition may explain, in a great many cases in a simple manner, the fixation of water of crystallisation upon salts and the formation of certain double salts; but here the hypothesis complicates itself, and becomes less capable of verification. We must interpose here the atomicities of the second order of numerous elements, and this can only be done in a useful manner after a long comparative investigation.

I may be permitted, in conclusion, to reply to an objection which has already been made to the theory of variable atomicity, and which will, doubtless, be more frequently raised, on account of the extension which I propose to give it. Not to admit for elements an atomicity as invariable as the atomic weight is, they say, to complicate the theory and to deprive it of its rigour. It seems to me that a theory loses more by leaving on one side the explanation of a considerable number of facts, than by accommodating itself so as to link them all to one principle. The principle is here the capacity of saturation of atoms, varying between limits more or less narrow; but such, nevertheless, that a small number of types of simple combinations enable us to comprehend the indefinite number of known bodies.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 99.)

Only the highest branch of industry, that in which justly no price is considered too high, as its object is health, to wit medicine has found the present methods sufficient to allow of the application of ozone. These endeavours were founded on the same observation first published by Schönbein, and subsequently placed beyond the reach of doubt by Andrews† that the air of towns, and even that of well-ventilated rooms in the country contains no ozone, whilst it can always be discovered in the open-air of the country, and the certainly unproved conjecture of Schönbein as to the connection between epidemics and a deficiency of ozone.

Latterly Lender has come forward as the advocate of the medical application and efficacy of ozone, which he recommends both as ozonised air and ozonised water in tuberculosis, rheumatism of the joints, glaucoma, asthma, gout, &c.‡ That his exertions have not met with the approval of the profession appears from a discussion of the Berlin Medical Society, Oct. 29, 1873, held under the presidency of Dr. Von Langenbeck.‖ Here the use of ozone was defended by Lender alone, and met with zealous opposition. O. Leibreich argued on this occasion that it was impossible to convey into the blood a body so unstable as ozone, which must be decomposed in the respiratory organs. Inhalations of ozone must, therefore, be merely inhalations of pure oxygen, whilst the disinfection of sick chambers may be effected by simpler and better means. Nevertheless, it is necessary to mention here the observations of Schöne§ and Houzeau¶ that after working with ozone, its peculiar odour adheres to the hands for some time, as well as to garments of flannel or other tissues. Its decomposition therefore appears not to be instantaneous. That the physiological action of strongly ozonised oxygen is very important, appears from the recent experiments of Dewar and MacKendrick.** Oxygen ozonised by induction, and containing at most 10 per cent. of ozone, killed small animals which were allowed to inhale it, such as rabbits, mice, and small birds, the two latter in 20 minutes. Respiration was rendered slower, the pulse was enfeebled, and the blood in all parts of the body was rendered venous. This remarkable phenomenon is considered by the observers as due to the high specific gravity of ozone (24), which exceeds that of carbonic acid (22), and thus retards the diffusion of the latter out of the blood. The irritant action of ozone upon the mucous membrane and its destructive effect upon tissues are recognised both by these observers and by earlier authorities. Redfern considered in 1857 that in his experiments oxygen containing 1-240th of ozone proved fatal to small animals in 30 seconds, producing congestion and emphysema of the lungs after enlargement of the right ventricle.††

Lender has established an ozone manufactory for medicinal purposes. It is announced that ozone inhalations

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* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† Andrews, *Nature*, 1874, p. 366.

‡ Lender, *Goschen's Deutsche Klinik*, 1872, 1873.

‖ *Klinische Wochenschrift*, 1873, 588, 589.

§ Schöne, *Berl. Chem. Ges.*, 1873, 1226.

¶ Houzeau, *Ann. Chim. Phys.* (4), xxvii., 16.

** Dewar and MacKendrick, *R. Soc. Edinb. Proc.* Session 1873-1874.

†† Andrews, *Nature*, 1874, 366.

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may be had at about 7½d. per cubic foot, or £1 per cubic metre. The method of preparation, and the strength in ozone, are not stated. Ozonised water, according to the degree of concentration, costs from 6d. to 1s. per bottle. This ozonised water was very carefully tested by Carius* with the unfavourable result that in 1000 grms., 0·0087 to 0·0095 grm., or less than 1-1000th per cent. of ozone, was present. Chlorine and hypochlorous acid were not detected. On the other hand, Behrens and Jacobsen† say that nothing but hypochlorous acid is found in commercial ozone-water. According to the experiments of Carius, the absorption coefficient of ozone in water is so small that the above-mentioned figures border very closely upon the highest possible quantity.

SOCIETY OF PUBLIC ANALYSTS.

"THE SALE OF FOOD AND DRUGS ACT 1875.‡"

By G. W. WIGNER and J. H. SCOTT.

The object of this paper is to point out the chief points of difference between the "Adulteration of Food Act, 1872," and the "Sale of Food and Drugs Act, 1875," and to indicate the more salient features of the latter measure. The intention of the writers is not to dogmatise but to suggest, and while disclaiming any pretension to interpret in a strictly legal sense the Act of Parliament, they venture to hope that an intimate acquaintance with the Bill in all its stages, and an almost daily consideration of its clauses during its progress through Parliament, with the corresponding clauses in the Bill it is intended to supersede, may enable them to render into familiar language the leading provisions of the Act, more especially those which are likely to affect Public Analysts.

As the Act of 1872 contains only 12 clauses, and that of this year 36, it is impossible to compare the two Acts, clause against clause, but it is proposed to consider *seriatim* the provisions of the two Bills. It will be understood that, except where occasion appears to demand it, the verbiage of the clauses will not be quoted, but only their manifest intent given. The preamble of the Act of 1872 states that its object is the repression by more effectual laws of "the practice of adulterating articles of food and drink and drugs."

The Act of 1875 simply recites that "it is desirable that the Acts now in force be repealed, and that the law regarding the sale of food and drugs in a pure and genuine condition should be amended.

The first law is avowedly to put down the adulteration of food, and yet it contains no definition either of what is meant by "adulteration" nor what is to be understood by "food." In the new Act the word "adulteration" is studiously and intentionally dispensed with, the Government confessing their inability either to frame a satisfactory one or to accept the one which, after much deliberation, the "Society of Public Analysts" had drawn up, but it does contain a clear and comprehensive definition of what is to be understood by food and drugs, namely:—"The term 'food' shall include every article used for food or drink by man, other than drugs or water: the term 'drug' shall include medicine for internal or external use." The fact that water is not to be considered "food" is important to Public Analysts, as it will ensure that for water analysis proper fees can be charged. Clause 1 in the expiring Act and clause 3 in the new one treat of substantially the same offence, and subject the offender to a like penalty, but the phraseology of the later measure appears very much preferable.

According to the former Bill it must be proved that the offender has "wilfully admixed" the article sold with some foreign substance which must *of itself* be "injurious to health." In the latter the words "knowingly" (which at first appeared) and "wilfully" are designedly avoided, it being, as is well known, next to impossible to produce proof of such knowledge, and instead of the adulterant being itself described as "injurious to health" its use is only forbidden if it render the article adulterated "injurious to health."

In the clause referred to, in the older Act, drugs are placed in exactly the same category as food, and it must also be noted that this clause refers only to the offence of *adulterating*, the punishment for *selling an adulterated article* being a lighter one provided for in a subsequent section, whereas in the Act of 1875 the punishment is the same for the person selling the debased article as for the person debasing it. In the new Act a wise distinction in the description of the offence as it regards food and drugs is drawn, in the former case it being described as "rendering the article (of food) injurious to health," and in the latter (drugs) of adding anything "to affect injuriously the quality or potency of the drug."

As the penalty alike for injuriously tampering with the goods and for selling goods so tampered with is £50 for the first offence, and six months' imprisonment for subsequent offences, and as no proof of knowledge is required in order to ensure a conviction, it will be obvious that but for some qualification this clause would in certain cases bear very hardly on tradesmen guilty of no more heinous offence than that of not being experts. It is, therefore, "provided that no person shall be liable to be convicted under either of the two last foregoing sections of this Act in respect of the sale of any article of food, or of any drug, if he shows to the satisfaction of the justice or court before whom he is charged that he did not know of the article of food or drug sold by him being so mixed, coloured, stained, or powdered as in either of those sections mentioned, and that he could not with reasonable diligence have obtained that knowledge."

This will give a tradesman who has bought honestly an impure article an opportunity of proving his innocence and shifting the blame on to the right shoulders.

The difference in effect between the corresponding clauses in the two Bills is that under the former one no conviction could be secured unless the prosecution could prove that the defendant had "wilfully" admixed, &c., while under the latter the proof that the forbidden admixture is present is sufficient, unless the defendant can show to the satisfaction of the Justices that, not only did he not know of the impurity, *but* that "he could not with reasonable diligence have obtained that knowledge." The increased effectiveness of the law as it is altered cannot fail to be appreciated.

In clause 2 of the old Bill a penalty of £20 is imposed for selling an article with which, *to the knowledge of the seller*, any ingredient injurious to health is mixed; but, as this knowledge must be proved, it is manifest that, so far, it must be even more inoperative than clause 1.

It is, however, provided, in the same clause, that "every person who shall sell as unadulterated an article which is adulterated" shall be fined; and, as this is without the qualification of "knowingly," it is only under this section that convictions have been obtained, except in rare instances where the Act has been imperfectly understood and loosely administered.

In clause 3 of the 1872 Act, selling articles that have been mixed with other substances for the purpose of increasing weight or bulk is forbidden; but as this, too, must be proved to have been done "knowingly," the same difficulty as has been already mentioned exists. In clause 2, just referred to, the offence is "selling as unadulterated an article that is adulterated," and, in the absence of any definition of "adulteration," a wide margin is left for differences of opinion as to what was and what was not adulteration.

The corresponding clause (6) in the new Act now reads—

* Carius, *Ber. Chem. Ges.*, v., 520, and vi., 806.
† Behrens and Jacobsen, *Vierteljahrschrift f. Pr. Pharm. von Wittstein*, xxii., 230, 1873.
‡ Read at a meeting of the Society of Public Analysts at the Museum and Library, Bristol, August 26, 1875.

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"No person shall sell to the prejudice of the purchaser any article of food or any drug which is not of the nature, substance, and quality of the article demanded by such purchaser, under a penalty not exceeding twenty pounds;" but is qualified by certain exceptions which deserve careful consideration, and which are "provided that an offence shall not be deemed to be committed under this section in the following cases; that is to say,"—

"(1). Where any matter or ingredient not injurious to health has been added to the food or drug because the same is required for the production or preparation thereof as an article of commerce, in a state fit for carriage or consumption, and not fraudulently to increase the bulk, weight, or measure of the food or drug, or conceal the inferior quality thereof;

"(2). Where the drug or food is a proprietary medicine, or is the subject of a patent in force, and is supplied in the state required by the specification of the patent;

"(3). Where the food or drug is compounded as in this Act mentioned;

"(4). Where the food or drug is unavoidably mixed with some extraneous matter in the process of collection or preparation."

It cannot be denied that, under the first and fourth of these exceptions, articles may be sold which are not chemically pure, but yet, read by the light of common sense, it does not appear that miscarriages of justice are likely to be frequent. Exceptions 2 and 3 will be admitted to be not only unobjectionable but absolutely necessary.

It is very important to notice that, by clause 24 (which appears to be out of its proper place), if any defendant intends to rely upon any of these exceptions for his defence, he must *prove* that the mixture is justified by the exception. The incidence of the onus of proof in this case is of the utmost importance.

In the Bill of 1872 the Pharmacy Act of 1868 was incorporated. In the present measure it is not, and the provisions as to drugs are of the simplest character, viz.:—

(1). The "quality or potency" of the drug shall not be injuriously affected (clause 4).

(2). Proprietary or patent medicines may be sold (clause 6).

(3). Compounded drugs (as well as compound articles of food) shall be compounded in accordance with the demand of the purchaser (clause 7).

In the last-named clause, it was proposed by the House of Commons to introduce certain stipulations as to drugs being in accordance with the British Pharmacopœia or with sundry other authorities, but it is quite a question whether, practically, the whole ground is not covered by the simpler method at last decided on.

Clause 8 refers to mixed drugs, and qualifies clause 7 to the extent that no offence shall be deemed to have been committed if the following conditions, which it is necessary to observe are conjunctive, not alternative, are observed:—

(1). The mixture must be declared by a "distinct and legible" label.

(2). The added matter must not be "injurious to health."

(3). The admixture must not be intended fraudulently to increase the bulk, weight, or measure, or to conceal the inferior quality of the drug.

It may be open to argument, What loopholes for the sale of impure or deleterious drugs may be possible under these exceptions? but it does not seem likely that, if they are interpreted fairly, there can be much room for adulteration.

Clause 9 has no analogue in the old Act. It may be termed the "abstraction" clause, and makes it punishable to reduce the quality of any article by the abstraction of any part of it "so as to affect injuriously its quality, substance, or nature."

This will be admitted, by even the most adverse critics of the Bill, to be a step in the right direction, and it will specially recommend itself to those Analysts who have had to deal with the hitherto unpunishable but injurious custom of selling skimmed milk without so declaring it.

Clause 5 in the old and clause 10 in the new Act alike relate to the appointing bodies, which remain substantially the same.

Under both Acts the appointments are optional to this extent: that the bodies specified may appoint Analysts, and, when requested by the Local Government Board, *shall* do so; and in the new Act it is further ordered that, whenever an appointment has already been made, and the same becomes vacant, the vacancy *shall* be filled up.

The chief novelty in this clause is the provision that any person directly or indirectly connected with the sale of food or drugs shall be ineligible for the office of Public Analyst "for such place." This is, however, of course, not retrospective, and will not, therefore, affect any appointments already made.

Clause 11 gives power to any Town Council, &c., to appoint the Analyst for any neighbouring borough or county to act for their district "during such time as the said appointing body shall think fit," they making due provision for the payment of the Analyst's remuneration.

Clause 12 enacts that, where an Analyst is appointed, "any purchaser" shall be entitled, on payment of a fee not exceeding 10s. 6d., to have any article analysed; but it must be noted, in contradistinction to a somewhat similar provision in clause 9 of the Act of 1872, that the article must be taken direct to the Analyst and the fee paid to him, instead of both sample and fee being handed to the inspector. This alteration is very unacceptable to some Analysts, who fear they will be flooded with private samples at low fees; but an enquiry into the number of samples which have hitherto been taken to the inspectors will show that such a fear is exaggerated, if not groundless.

This clause also provides that, if there be no Analyst for the district, the purchaser may take his sample "to the Analyst of another place," but in such case the fee paid shall be "such as may be agreed upon between such person and the Analyst."

Clause 6 in the 1872 Act, and clause 13 in the Act of this year, referring to the purchase of samples by inspectors, are substantially the same. They are both open to the objection that they provide only for the analysis of "suspected" articles, and though, *theoretically*, they might lead to the utter break down of the Act, if the inspectors were allowed to purchase samples with public money and then resolutely refuse to "suspect" them, yet, practically, it may safely be left to the appointing bodies to take care that whatever samples are purchased for the purpose of analysis *shall* be analysed.

This clause also makes the important provision that, if any district chooses to appoint an inspector, but not an Analyst, the former may take any samples to the Analyst of another place, who shall analyse them on terms to be agreed upon between them. This will enable the authorities of any small place to have a number of analyses performed experimentally before making a permanent appointment.

It will also be noted that Medical Officers of Health are competent to act as inspectors, and cases may easily be imagined where their power to do so may be productive of much good.

The next point to be considered is the plan prescribed for the taking of samples by the inspectors. The directions in the Act of 1872 are very scanty.

Clause 6 says that the inspector shall procure and submit samples to be analysed by the Analyst; and clause 10 directs that such samples shall be divided and sealed "in the presence of the Analysts by the inspectors," the latter to retain a portion of each sample in case a further analysis should be ordered. It will be necessary to read clauses 14 and 15 of the new Act. They are:—

"14. The person purchasing any article with the inten-

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tion of submitting the same to analysis shall, after the purchase shall have been completed, forthwith notify to the seller or his agent selling the article his intention to have the same analysed by the Public Analyst, and shall offer to divide the article into three parts to be then and there separated, and each part to be marked and sealed or fastened up in such manner as its nature will permit, and shall, if required to do so, proceed accordingly, and shall deliver one of the parts to the seller or his agent.

"He shall afterwards retain one of the said parts for future comparison and submit the third part, if he deems it right to have the article analysed, to the analyst.

"15. If the seller or his agent do not accept the offer of the purchaser to divide the article purchased in his presence, the Analyst receiving the article for analysis shall divide the same into two parts, and shall seal or fasten up one of those parts and shall cause it to be delivered, either upon receipt of the sample or when he supplies his certificate to the purchaser, who shall retain the same for production in case proceedings shall afterwards be taken in the matter."

It will thus be seen that the inspector, on purchasing a sample, is bound (unless the vendor waives his right) to divide it into three parts there and then, to seal up each portion, hand one to the vendor, take one to his own house, and submit the third one only to the Analyst.

From an Analyst's point of view the objections to this plan are very great, as two-thirds of every sample purchased he will never see at all, and if his analysis be disputed, and a second analysis, made on the inspector's or dealer's portion, contradicts his results, he will be more likely even than at present (and with better reason) to doubt if the separate portions have really formed part of the same sample.

Inspectors, too, are not usually so expert at tying up parcels securely as are shopkeepers, and if the parcel is only clumsily secured the difficulty would not be great, and the temptation to a vendor who knew he had sold an impure article would be considerable, to substitute another sample of different quality.

But, beyond this, there is the *possibility* of such a thing as collusion between an inspector and a shopkeeper, in which case the reputation of the Analyst would be in considerable peril.

Most strenuous efforts were made to obtain a modification of this clause during the time the Bill was before Parliament, but without success. The feeling outside the chemical circle was universal that a dealer had a fair right to have a portion of any sample upon which he might be prosecuted left in his own custody, for the purpose of having an independent analysis made, and this is not a claim to be easily gainsaid.

It was then urged on the Government that, if the inspector leave one-third of the sample with the vendor, he should take the other two-thirds *intact* to the Analyst, to be there divided, but this very reasonable proposal was not accepted.

Perhaps the Analyst might adopt one safeguard by insisting that the quantity of the article should be sufficiently large to insure that a third part of it would, after his analysis was made, still leave him enough for any further analysis which he might wish, in his own defence, to have made.

It will be seen that, by clause 15, if the dealer does not wish to have the article divided, it will be taken, as now, to the Analyst entire, and will be divided by him, he handing one part back to the inspector, either when he receives it or when sending his certificate.

Clause 16 makes it legal to send samples by post, and this provision, which may be convenient in some cases, has been the cause, to a very great extent, of the objectionable feature in clause 14.

Clause 17 provides that, if a vendor refuses to supply an inspector with any article "exposed for sale," or "on sale by retail," upon the price being tendered for it, he shall be liable to a penalty of £10. This regulation meets a difficulty that has been constantly occurring under the old Act, where, the inspectors being known to the dealers, the latter have often absolutely refused to serve them.

It has been urged that the penalty imposed for the offence is too small, and that some vendors would prefer to pay £10 rather than have the impurity of their goods exposed.

It must not, however, be forgotten that, if a man were convicted of refusing to serve an inspector, such conviction would hardly do him less injury with his customers than a conviction for adulteration. Moreover, if he looked upon the fine of £10 as only a trifle, it would be open to the inspector to pay him a visit daily, and for each refusal to prosecute him.

Clause 7 of the 1872 Bill enacts that Analysts shall report quarterly to their appointing bodies, and that their reports shall be *read* at the meetings of the local authorities.

In clause 19 of the 1875 Act, the word "presented" is substituted for "read," but it is further ordered that the appointing bodies shall transmit annually to the Local Government Board a certified copy of each quarterly report of the Analyst. In clause 9 of the older Act, it is laid down that "in the absence of any evidence before the Court to the contrary, the Analyst's certificate shall be sufficient evidence of the matters therein certified."

This is substantially repeated in clause 21 of the 1875 Act, but is followed by the words "unless the defendant shall require that the Analyst shall be called as a witness." For such attendance the Analyst of course should be paid, and, though the Act itself is silent on the point, the opinion of the Local Government Board is distinctly to that effect. This clause also provides that the defendant and his wife may tender themselves as witnesses.

Clause 22, which provides that, at the discretion of the Justices, reference analyses shall be performed by the Somerset House officials, has been throughout strongly (though unsuccessfully) resisted by the Analysts, not because they are afraid of having their work checked by chemists of equal standing and experience with themselves, but because the standing and experience of the Inland Revenue chemists is altogether unknown. However, the clause stands, and it is to be hoped that, before the Somerset House laboratory has any food samples submitted to it, care will be taken that their staff is strong enough for the work. If this is not found to be so, it will behove Analysts who are satisfied of their own correctness (and all *should* be so) to take such precautions as will enable them to vindicate their results, even if they should be contradicted by Somerset House.

Clause 25 provides for the acquittal of a defendant if he can prove, to the satisfaction of the Justices, that he had purchased the article as the same the purchaser demanded of him, believed it to be the same, and held a warranty from the wholesale dealer that it was so; but, unless he has given due notice that he will rely upon this defence, he shall be liable to pay the costs of the prosecution.

In clause 26 it is provided that all penalties imposed, where prosecutions are instituted by the inspectors on behalf of the local authorities, shall be paid to such inspectors, and by them handed over to the local authorities for which they act, "to be applied towards the expenses of executing this Act, any statute to the contrary notwithstanding."

The great importance of this new provision will be at once apparent, and it ought to remove all the objections on the score of expense, which some Boards have urged against the appointment of an Analyst, as in many cases the amount of the fines will go a long way towards paying the cost of the prosecutions and the Analyst's salary. Hitherto, as is well known, the amount of the penalties recovered has gone to a general police fund.

Clause 27 provides a punishment for persons guilty of forging warranties, or uttering the same knowing them to be forged, of two years' hard labour; for persons misapplying a warranty (that is, using it for an article other

than the one it was given for), to a fine of £20; for persons giving a false warranty, a fine of £20; and for "every person who shall wilfully give a label with any article sold by him which shall falsely describe the article sold," a penalty of £20.

Clause 28 states that nothing in the present Act shall affect the power of proceeding by indictment, or take away any other remedy, or in any way interfere with contracts and bargains between individuals, and the rights and remedies belonging thereto; and it further enacts that, in any case where a prosecution for breach of contract is instituted, the plaintiff can recover, in addition to all other damages which he has sustained by the breach, "the amount of any penalty in which he may have been convicted under this Act, together with all costs paid by him upon such conviction and those incurred by him in and about his defence thereto."

Clause 30 makes special provision as to the examination of all tea imported, by persons to be appointed by the Custom House, and to this clause the tea trade attaches great importance.

It will, doubtless, stop, to a very great extent, the importation of adulterated tea, but will in no way interfere with an examination by Public Analysts of any suspected samples which may be submitted to them.

In the "Adulteration Act, 1872," the form of certificate was left entirely to the taste of the individual Analysts and Boards. In the "Sale of Food and Drugs Act, 1875," a set form is prescribed, which is printed as a schedule to the Bill. It is needlessly cumbrous and wordy, and presents the following objectionable features:—

(1). The weight of the sample on its receipt is to be stated, unless this "cannot be conveniently done."

(2). If the sample is found to be genuine, nothing but the bare fact need be stated; but, if it be adulterated, it is necessary to give the proportions of the component parts, or the quantity of the adulterant, thus involving a quantitative analysis.

(3). In the case of "milk, butter, or any article liable to decomposition," the Analyst is to report specially whether any change had taken place in the article that would interfere with the analysis.

We have thus reviewed, as briefly as the nature of the matter allowed, the new Act, and, after dispassionately considering it, have arrived at the conclusion that, as far as it is possible to form an opinion of the working of an Act of Parliament which has not yet been put into operation, it is a sounder and more comprehensive measure than the one it repeals.

To those who have only seen the Bill as originally drafted, and formed their opinion on that draft, this expression of commendation will, doubtless, be surprising, but probably few Acts of Parliament of the same length have ever undergone a more complete metamorphosis in their passage through the two Houses.

It is not too much to say that the Act, as finally passed, is essentially a different measure to the one introduced in the early part of the session by the President of the Local Government Board, and that for the very numerous and important amendments introduced, the Society of Public Analysts may honestly lay claim to the largest share of credit.

CORRESPONDENCE.

OUR PATENT LAW.

To the Editor of the Chemical News.

Sir,—I am not about to controvert the remarks you have made upon the above subject, in noticing Mr Higgins's "Digest of Patent Cases."

My object is merely to relate the history of a case which occurred to myself, and which I believe may occur again under the existing conditions of our Patent Law. It is not from any fear of consequences that I withhold the real names in this narrative, because all that can be done has been done long ago in regard to public exposure; and this too with no other result than the harmless expression of Pistol's desire to "horribly revenge." I intend, therefore, to follow the simple A B C style of narration, and for this purpose shall bring in a Scottish merchant named A., and an Englishman named B. Several years ago this merchant A. applied to me to assist him in the completion of a patent, which he wished to take out for the production of oil from bituminous coal. At that time I was on, what I supposed to be, terms of friendship with the man B., to whom indeed I had been, and then was of considerable use gratuitously. It did not consequently surprise me when this man offered me the use of his office and an open desk to carry on my correspondence with the merchant A; it seemed, in fact, a mere outburst of gratitude. Matters went on as may be supposed,—a carefully conducted set of chemical experiments ended in the realisation of an improved mode of distilling coal for the production of mineral oils. The merchant A. applied for a patent, only, however, to discover that a patent for the self-same thing, carried out in the self-same way, had been granted the day before to a "foreigner residing abroad."

Suffice it to say that this "foreigner" was traced out step by step, and at length fairly unmasked in the person of the Englishman B. As, however, the Scottish merchant A. had spent much money upon his experiments, no other recourse was left him than to purchase the patent of the man B., and this he did for the sum of £70 sterling.

Meantime, impressed with the idea that I was in collusion with the man B., the merchant A. discontinued to correspond with me; and I, thinking his silence an example of Scottish gratitude, quietly allowed our acquaintance to drop; nor was it until several years after that I got to know the real circumstances of the case, although during all this time I continued in my ignorance to render gratuitous services to the man B.

How much injury this thing did me in a professional point of view I have no means of knowing, nor do I very much care, for my position in life has placed me beyond the influence of such injury. But in a national aspect the matter assumes a more serious form, and perhaps, upon reflection, you may think the present efforts of the Lord Chancellor not altogether uncalled for, even though they may prove unsuccessful.

In my opinion the Patent Law ought to be entirely abolished, and a system of national rewards instituted in its place; but the discussion of this question would lead me beyond the limits of a scientific journal like yours.—I am, &c.,

Lewis Thompson.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—My friend Mr. Rudler has unearthed an old fact of some significance, of which I had no idea.

There really existed a "British Mineralogical Society," which was blended with the Askesian Society before it went to the tomb of the Capulets!

One can easily understand, how, in the days of "*The Four Elements*" (1806), that "pure mineralogy was not sufficient to keep the Society in healthy activity."

In this year of grace, 1875, Mineralogy (alas! far from being pure and simple) *could* keep a society in healthful activity. There is no doubt about that.

If we had a Mineralogical Society just now, I would humbly ask of it information as to the minerals Kjerulfine, Uranosphærite, Uranospinite, Vaalite, and Zennerite. Whether they happen to be old acquaintances with new faces, or strangers with an old appearance?

But we have no Mineralogical Society. I fancy there

ought to be one. Is it too late to do well? or too soon to begin?

T. A. Readwin.

Liverpool, August 23, 1875.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—My letter under this heading, which appeared in the Chemical News (vol. xxxii., p. 29) has led to my receiving a number of private communications from mineralogists who desire to join in the establishment of a "Mineralogical Society of Great Britain and Ireland."

It appears to me that a Mineralogical Society should aim at the following objects:—

1. To simplify mineralogical nomenclature.
2. To determine and define doubtful species.
3. To measure, determine, and illustrate forms of crystallisation, especially the irregularities and peculiarities of particular planes, or of crystals from particular localities.
4. To study the *Paragenesis* of minerals.
5. To record instances and modes of pseudomorphism with their accompanying phenomena.
6. To discuss rival systems of classification, and establish a natural system.
7. To promote the exchange of specimens.
8. To collect, record, and digest facts and statistics relating to economic mineralogy.

I have already received the names of several eminent mineralogists who are desirous of joining in this work, and shall be glad to receive as many other names as possible before further steps are taken in the matter.—I am, &c.,

J. H. Collins.

57, Lemon Street, Truro,
August 24, 1875.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—Professor Dana's "System of Mineralogy" (1874) enumerates exactly 925 mineral species. (I tried to count the varieties, and "caved in.")

The "Index of the Mineral species with their varieties contained in the British Museum" (January 1, 1875), gives the names of 690 mineral species and 722 varieties.

Comparing the latter with the former, I find more than 200 discrepancies in nomenclature, and that our National Collection contains 235 *fewer* mineral species than are catalogued in Dana's "Mineralogy." Taking the more remotely-modern authors, the discrepancies become largely increased.

Also, I find, scattered up and down "our unsatisfactory mineralogical literature," something like 1166 so-called mineral species, and about 1650 varieties. A goodly number of these have been autocratically ignored by "the powers that be," albeit they were introduced to the world under the most respectable patronage of the time being. I have shown in previous communications that very many of these so-called mineral species are of extremely doubtful character, and that some of them appear to be rank impostors.

Some of the questions that naturally arise out of these simple statistics are:—

1. How is it (in what ought to approximate to an exact science) there are so many discrepancies in its nomenclature?

2. How is it that our National Collection lags so very far behind in the acquisition of authenticated mineral species?

3. Whether the points upon which the two great authorities are *agreed* are in themselves altogether appropriate (and, *therefore*, to be fixed for ever); whether the points on which they *differ* are irreconcilable; and, whether some other authorities outside the enchanted circle, and *differing from both the autocrats*, may not be taken as equally reliable?

4. Whether and how it is possible to change a state of things that is at last admitted on all sides to be a disgraceful hindrance to the advancement of science?

Now, Sir, it has all along appeared to me that an *independent* Society of men (and women if they have a mind to), whose avocations and likings are more or less akin to the study of inorganic substances, can be the only remedy for the mineralogical ills that we have so innocently inherited.

A Mineralogical Society, as cosmopolitan as possible, may be an inexpensive society. A yearly fee of a guinea would amply suffice; and I cannot help thinking, Sir, that if you will only add a foot-note to the effect that notes of adhesion to this crude idea, addressed "*Mineralogical Society*," may be sent to your office, some good will come of it.—I am, &c.,

T. A. R.

Liverpool, August 31, 1875.

[We shall be glad to receive communications on this subject.—Ed. *C. N.*]

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, tome lxxxi., No. 6, August 9, 1875.

Notice of a Blue Matter found in Clay.—M. P. Thenard.—The author exhibited a specimen of clay, which, when dug up a fortnight previously, was of a deep grey, but had since become black by exposure to the sun, with portions of a blue matter of the colour of ultramarine. The clay was obtained from the trenches of a water-mill which is being constructed at Perrigny sur l'Ognon (*Côte d'Or*), on the site of a forge, which has disappeared a century ago. This matter takes an olive-green if heated to 120°, and begins to change already at 100°. If treated in the cold with solution of potassa it turns yellow. Ammonia has no action, neither has acetic acid. Chlorine water modifies it but slowly; but hydrochloric acid, even very dilute, dissolves it at once, causing it to lose its colour, which an addition of ammonia does not restore. It contains a predominant quantity of ferrous oxide; ferric oxide and lime are wanting; alumina is present, though in smaller proportion than lime. There are notable quantities of a nitrogenous organic acid, and phosphoric acid is probably present. Silica is only in very small amount.

Calorimetric Study of the Silicides of Iron and Manganese.—MM. Troost and P. Hautefeuille.—Silicon in combining with manganese disengages much heat, and forms with this metal very stable compounds, as has been already demonstrated in case of carbon. The correspondence between silicon and carbon extends to their behaviour with iron, in which they both seem to dissolve, their union being attended with little, if any, disengagement of heat.

Researches on the Niobates and Tantalates.—M A. Joly.—The researches of M. de Marignac on the alkaline fluo-niobates and fluo-tantalates have led to the formulæ Nb_2O_5 and Ta_2O_5 for niobic and tantalic acids respectively, which have been confirmed by the vapour-densities of the chloride, Nb_2Cl_5; and oxychloride of niobium, $Nb_2O_2Cl_3$; and of the chloride of tantalum, as determined by MM. Sainte-Claire Deville and Troost. Niobic and tantalic acids approximate, in their formulæ at least, to vanadic acid, which the researches of Prof. Roscoe have enabled us to classify, in accordance

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with the totality of its chemical properties along with phosphoric and arsenic acids. The three latter acids may be tribasic, and their salts associated with fluorine and chlorine form apatites and wagnerites. The author finds that niobic acid in its combination with bases gives rise to four classes of salts—MO,Nb_2O_5; $2MO,Nb_2O_5$; $3MO,Nb_2O_5$; $4MO,Nb_2O_5$. He gives a detailed account of the niobates and tantalates of magnesia, the niobates of lime, manganese, iron, and yttria. Niobic and tantalic acids can be tetrabasic; and the author has not succeeded in producing with them compounds analogous to the apatites and wagnerites. Hence these two acids cannot be placed along with the acids of the phosphoric series.

Facts Relative to the Study of the Polyatomic Acids, properly so called: Application to a New Method of obtaining Crystalline Formic Acid.—M. Lorin.—85 grms. of erythrite are treated in successive portions with 2·4 kilos. of oxalic acid, and yields 1120 of aqueous formic acid, containing 985 of real acid, or 87·95 per cent. If the first aqueous acids are allowed to escape, we obtain formic acid of the average strength of 90·4, and for the last portions the average is 96. The rectification of these last portions furnishes acid of a strength exceeding 98 per cent, from which, by a duly regulated distillation, the crystalline acid is obtainable.

MISCELLANEOUS.

British Association for the Advancement of Science.—At the general meeting of the Association, held on Wednesday afternoon, Captain Douglas Galton stated that one of the principal functions of the Association was to spend the money it received in the promotion of science. There had already been spent by the Association £38,000. The list of grants, which was then read, included the following:—Mathematics and Physics. Professor Cayley, Printing Mathematical Tables, £159 4s. 2d.; Mr. Brooke, British Rainfall, £100; Mr. J. Glaisher, Luminous Meteors (£25 renewed), £30; Professor C. Maxwell, Testing the Exactness of Ohm's Law (renewed), £50; Professor Stokes, Reflective Power of Silver and other Substances (renewed), £20; Professor Tait, Thermo-Electricity (renewed), £50; Sir W. Thomson, Tide Calculating Machine, £200. Chemistry. Professor Roscoe, Specific volume of Liquids, £25; Dr. Armstrong, Isomeric Cresols and the Law of Substitution in the Phenol Series, £10; Mr. F. Clowes, Action of Ethylbromobutyrate on Ethyl Sod-aceto-acetate, £10; Mr. Allen, Estimation of Potash and Phosphoric Acid, £20. Mr. Bramwell moved a vote of thanks to the Mayor, the local officers, and Executive Committee, which was seconded by Professor Balfour Stewart, and cordially adopted. Mr. Griffith gave the following statement of the attendances and money received during the meeting at Bristol:—Old life members, 240; new life members, 36 (£359); old annual members, 296 (£296); new annual members, 93 (£186); associates, 884 (£884); ladies, 672 (£672); foreign members, 17. Total attendances, 2249; total money received, £2397. A vote of thanks to Sir John Hawkshaw, proposed by Sir William Thomson, seconded by Dr. Carpenter, and carried by acclamation, brought the successful meeting at Bristol to a close. The meeting of the British Association for 1876 will be held at Glasgow, and will commence on September 6. Sir Robert Christison, Edinburgh, has been nominated president elect, and the vice-presidents chosen are the Duke of Argyll, Sir William Stirling-Maxwell, Sir William Thomson, the Lord Provost of Glasgow, Dr. Allen Thomson, and Professor A. C. Ramsay. The meeting for 1877 will be held at Plymouth.

The following is a complete list of the papers brought before the Chemical Science Section of the Bristol Meeting, under the presidency of Professor A. Vernon Harcourt. They will be published in full or in abstract, according to their importance, in the CHEMICAL NEWS.

Prof. T. E. Thorpe.—Report of the Committee for the purpose of Determining the Specific Volumes of Liquids.

W. Chandler Roberts.—Report of the Committee for the purpose of Investigating the Methods of Making Gold Assays, and stating the results thereof.

Henry T. Chamberlain.—Some account of the Manufacture and Refining of Sugar in Bristol, 1875.

Thomas Davey.—The Tobacco Trade of Bristol.

A. S. Davis.—A Simple Method of Determining the Proportion of Carbonic Acid in Air.

A. Vernon Harcourt, F.R.S.—On an Apparatus for Estimating Carbon Bisulphide in Coal-Gas.

Professor A. W. Williamson, F.R.S.—Report of the Committee for the purpose of superintending the publication by the Chemical Society of the Monthly Reports on the Progress of Chemistry.

P. S. Evans.—On Tanning.

Dr. J. Watts.—On Muntz and Rampacker's Apparatus for the Estimation of Tannic Acid.

Dr. W. A. Tilden.—Researches on the Crystalline Constituents of Aloes.

G. H. Beckett and *Dr. C. R. A. Wright.*—On Japanese Camphor from Peppermint.

G. H. Beckett and *Dr. C. R. A. Wright.*—On the Alkaloids of the Aconites.

F. Clowes, B.Sc.—On the Action of Ethyl-Bromobutyrate on Ethyl-Acetosodacetate.

Dr. T. L. Phipson.—On Noctilucine.

Dr. H. E. Armstrong.—Report on Isomeric Cresols, and on the Law which governs Substitution in the Phenol Series.

Prof. Cayley.—On the Analytical Forms called Trees, with application to the Theory of Chemical Combinations.

P. Braham.—Some further Experiments on Crystallisation of Metals by Electricity.

J. W. Gatehouse.—On Nitrite of Silver.

T. Fairley, F.R.S.E.—On New Solvents for Gold, Silver, Platinum, &c., with Explanation of so-called Catalytic Action of these Metals and their Salts on Hydrogen Dioxide.

T. Fairley, F.R.S.E.—On the Use of Potassium Dichromate in Grove's and Bunsen's Batteries to ensure constancy.

A. H. Allen.—Report of the Committee for the purpose of Examining and Reporting upon the Methods employed in the Estimation of Potash and Phosphoric Acid in Commercial Products and on the mode of stating the results.

Prof. Corfield, M.D.—Report of the Sewage Committee.

J. C. Melliss.—Treatment of Sewage.

C. T. Kingzett.—On the Oxidation of Essential Oils.

Prof. A. Oppenheim.—Some remarks on Oxyuvitic Acid.

L. Jackson and *A. Oppenheim.*—Derivatives of Mercaptan.

Dr. H. E. Armstrong.—On the Nature of Berthelot's Vinylic Alcohol.

Professor T. E. Thorpe.—On a New Gaseous Compound of Fluorine and Phosphorus.

T. Fairley, F.R.S.E.—On a New Process for the Separation of Lead, Silver, and Mercury (Mercurous) Salts.

T. Fairley, F.R.S.E.—On a Process for the Preparation of Periodates, with their Application as a Test for Iodine and Sodium.

Dr. J. H. Gladstone.—The Relation of the Arrangement of the Acids and Bases in a Mixture of Salts to the Original Manner of Combination.

Dr. J. H. Gladstone and *Alfred Tribe.*—Notes on the Copper-Zinc Couple.

Dr. J. H. Gladstone and *Alfred Tribe.*—On the Augmentation of the Chemical Activity of Aluminium by Contact with more Negative Metals.

Dr. Debus.—On the Chemical Theory of Gunpowder.

A. H. Allen.—A Method of Effecting the Solution of Difficultly Soluble Substances.

W. Thomson.—Observations on Apparatus and Modes of Examining for the Source of Polluted Air.

THE CHEMICAL NEWS.

VOL. XXXII. No. 824.

A WORD TO STUDENTS.

Now the various colleges and schools of science are on the point of resuming operations, it may not seem out of place if we address a few words of advice to those who are about to commence or to continue their course of study. We would ask, in the first place, what is their real object? Do they seek to become sound, thorough, accurate men of science, hoping, in some direction or other, to extend the boundaries of human knowledge? Or, is their purpose merely to "prepare" for some examination? Do they study to "know," or to "pass?" To the latter class we say very little. They require our pity, which would be largely mingled with contempt were we not aware that passing examinations is at present a necessary key to certain careers. Let those of them who are capable of better things, however, take courage. The day is coming when we shall recover from our present mania of imitating the Chinese, and when original research, and that only, will be the passport to honours and to official recognition.

To the genuine student, who seeks to measure his strength not against competitors, but against the unsolved mysteries of the universe, we say above all things, be a specialist! Make your selection according to your tastes, your faculties, and your opportunities, and then upon the branch so selected throw yourself with your whole time and your whole energies. Make yourself familiar with what has already been done in the department and acquire above all a mastery over the needful methods of research. In the course of your reading you will perceive where the unexplored ground lies, and the means of approaching it will at once suggest themselves to your mind if you examine the subject with perseverance and attention.

Now we know that the course we are suggesting is the very opposite to what the authorities of colleges will too often recommend. They do not like specialists. They set very little value on original research, because under our unfortunate regulations for higher education it counts for nothing in the eyes of the routine examiner. They will bid the student strive to become, in the cant phrase of the day, "a good man all round." This advice we consider essentially bad and misleading. In the first place the mere extent of every science is now so prodigiously enlarged that a thorough acquaintance with all sciences is simply impossible. The attempt at universal knowledge results in universal superficiality. Again, it is very common that a man who feels an eager interest in one branch of science is perfectly indifferent or even averse to others. Would it not be better both for himself and the world that he should concentrate his attention upon the former? It is strange and almost laughable that the division of labour, so fully recognised in practical life, is as yet so entirely ignored in the career of the student. We do not require the mason to be a proficient in saddlery, or the brass-founder in calico-printing. Yet we refuse to grant any degree to a chemist or a biologist unless he can pass certain philological tests!

It is obvious that the plan we recommend of special devotion to some one department of science from the earliest date when the peculiar bent of the student's mind can be recognised will not conduce to success at examinations. But we hold that examinations as at present conducted cannot in the least test the power of the student to undertake original research. The best originator, the man of fruitful, suggestive mind, is not by any means invariably the best learner. His brain is so full of novel ideas which he is busied in reducing into definite form and preparing for experimental verification that he is apt to turn a somewhat deaf ear to routine lessons. His mind is a *plenum*, into which entrance is difficult. We could if so inclined give numerous instances of great discoverers, living as well as dead, who, for this very reason have been counted as dunces in their school and college days. It is undoubtedly painful to any young man of ability and energy to find himself outstripped at examinations and regarded with contempt by shallow competitors and no less shallow teachers. But, says the old proverb, "He laughs best who laughs last." Who makes the better figure in the middle of life, "the good man all round" who has "passed" and then subsided into a decorous, but feeble mediocrity, or the specialist who has not "passed," but who can lay his hand on a pile of original investigations? To be useful to the world we must know some one thing well; and to succeed in life we must be able to do some one thing better if possible than any rival. The pansophist, great and original in every department of human knowledge, is as extinct as the megalasaurus, if, indeed, he ever existed.

One caution must be added: we have said that a man may be too great to succeed under the examinational system. Let not, however, every one who makes a wretched figure at an examination delude himself with the notion that he is an original genius. If he is, he will soon prove it by his works.

EXAMINATIONS OF THE UNIVERSITY OF LONDON.

CANDIDATES for any Degree granted by this University are required to have passed the Matriculation Examination, to which no candidate is admitted unless he has produced a certificate showing that he has completed his sixteenth year.

The Fee for this examination is £2.

The Examination will be held on Monday, January 10th, 1876. It is conducted by means of Printed Papers; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the Candidates to pass, *viva voce* questions to any Candidate in the subjects in which they are appointed to examine.

Candidates are not approved by the Examiners unless they have shown a competent knowledge in each of the following subjects:—1. Latin. 2. Any two of the following Languages:—Greek, French, and German. 3. The English Language, English History, and Modern Geography. 4. Mathematics. 5. Natural Philosophy. 6. Chemistry.

The Papers in Latin and Greek will contain passages to be translated into English, with questions in Grammar and in History and Geography arising out of the subjects of the book selected. Short and easy passages will also be set for translation from other books not so selected

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Examiners :—Elementary Substances and their Combinations, Electro-Chemistry, Radiant Chemical Action.

In the Examination for Honours, the Candidate, not being more than twenty-two years of age at the commencement of the Pass Examination, who most distinguishes himself in Chemistry or Experimental Physics, will receive an Exhibition of £40 per annum for the next two years.

SECOND B.Sc. EXAMINATION.

The Second B.Sc. Examination will commence on Monday, October 25th, 1876.

Candidates for this Examination who have not previously taken the Degree of B.A. are required either to have passed the First B.Sc. Examination at least one academical year previously, or to have passed the First M.B. Examination, in this University.

The Fee for this Examination is £5.

The Examination includes the following subjects :—

Mechanical and Natural Philosophy.

Statics, Dynamics, Hydrostatics, Hydraulics, and Pneumatics, Optics, and Astronomy, Organic Chemistry, Animal Physiology, Geology and Palæontology, Logic and Moral Philosophy. (The four last subjects are treated Experimentally, and also Mathematically so far as the subjects of the First B.Sc. Examination are applicable to them.)

A Certificate, under the Seal of the University, and signed by the Chancellor, will be delivered at the Public Presentation for Degrees to each Candidate who has passed.

EXAMINATION FOR HONOURS.

Any Candidate who has passed the Second B.Sc. Examination, and has not previously passed the Second B.A. Examination, may be examined at the Honours Examination next following the second B.Sc. Examination at which he has passed, for Honours in (1) Mathematics and Natural Philosophy, (2) Logic and Moral Philosophy, (3) Chemistry, (4) Zoology, and (5) Geology and Palæontology. And any Bachelor of Arts who has passed the Second B.Sc. Examination in Chemistry and in Geology and Palæontology may be examined for Honours in one or more of the above-mentioned subjects, provided he has gone through the Pass Examination in the corresponding subject or subjects immediately before; unless he had previously obtained a Scholarship at the Second B.A. Examination in either of the subjects which are common to it with the Second B.Sc. Examination, in which case he is not admissible to the Examination for Honours in that subject.

The Candidate, being not more than twenty-three years of age, who most distinguishes himself in Chemistry, will receive £50 per annum for the next two years, with the style of University Scholar.

DOCTOR OF SCIENCE.

The examination for the degree of Doctor of Science takes place annually within the first twenty-one days of June, and the examination in each branch occupies four days.

No Candidate is admitted to this Examination until after the expiration of two academical years from the time of his obtaining the degree of B.Sc. in this University.

Candidates for the Degree of D.Sc. in any year must give notice of their intention to the Registrar, and pay to him a fee of ten pounds on or before the 1st of April. If a Candidate fails to pass the examination, the fee is not returned to him; but he is admissible to any *one* subsequent D.Sc. Examination without the payment of any additional fee, provided that he give notice to the Registrar on or before the 1st of May.

For the degree of D.Sc., Chemical Candidates can be examined either in Inorganic or Organic Chemistry, but no Candidate will be approved by the Examiners unless he has shown a thorough practical knowledge of the Principal Subject, and a general acquaintance with the Subsidiary Subject or Subjects.

Inorganic Chemistry.

Principal Subject—Inorganic Chemistry.

Subsidiary Subjects—Either Organic Chemistry; or Mineralogy, Crystallography, and Chemical Technology in its relations to Inorganic Chemistry.

Organic Chemistry.

Principal Subject—Organic Chemistry.

Subsidiary Subjects—Either Inorganic Chemistry; or Chemical Technology in its relations to Organic Chemistry, and the Chemistry of Animal and Vegetable Life.

CHEMICAL LECTURES & LABORATORY INSTRUCTION.

ST. BARTHOLOMEW'S HOSPITAL & MEDICAL COLLEGE.

WINTER SESSION.

Lecturer.—Dr. W. J. Russell, F.R.S. Monday, Wednesday, and Friday, at 10 a.m. One Course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. W. J. Russell, F.R.S. Monday, Tuesday, and Friday, from 11 to 1. One Course, £2 2s.

Two classes are held at St. Bartholomew's Hospital in each year, for the convenience of gentlemen who are preparing for the Matriculation Examination at the University of London—from October to January, and from March to June.

The chemical class is conducted by T. Eltoft, F.C.S. Fee, £2 2s.

The class is not confined to students of the hospital.

A class in the subjects required for the Preliminary Scientific Examination is held from January to July, and includes all the subjects required. Chemistry is taught by H. E. Armstrong, Ph.D. Fee, £1 1s. Fee for chemicals, £1.

BERNERS COLLEGE OF CHEMISTRY AND THE EXPERIMENTAL SCIENCES,

44, BERNERS STREET, W.

Conducted by Professor E. V. Gardner, F.A.S., M.S.A.

The Laboratory is open morning and evening throughout the year. Conveniences made for private students, whose studies are under the immediate charge of Professor Gardner and his Assistants.

The subjects of Geology, Botany, and Mineralogy are in the hands of competent teachers, whose arrangements depend upon the number of members joining the class or classes.

Courses of Lectures on Electricity, Galvanism, Magnetism, &c., embracing the department of "Experimental Science" required by the Government Council of Education, are regularly established, and can be joined at any time.

The classes on the Science and Practice of Steam, and of Photography, are formed three times a year. Times of meeting, by mutual arrangement of the students and the Professor.

A Matriculation Course of Lectures on Heat and Chemistry, commencing in October. Fee, £4 4s.. The same course can be pursued in private study, commencing at other periods if preferred. It embraces all that is required by the Government and London University Matriculation Examinations.

Tutorial Department.—Provision has been made by which gentlemen can be conducted through any or all of the different branches of study required for the various examining boards, viz :—Classics, Mathematics, English, Greek, Latin, French, German, Drawing (Mechanical, Free-hand, and Object), Mechanics, Chemistry, and the

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Natural and Experimental Sciences—in the class-rooms at Berners College.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION.

EVENING CLASSES.

Lecturer on Chemistry.—Mr. G. Chaloner, F.C.S. Tuesdays, 8.30 to 9.30, commencing October 5.

Manipulation and Analysis.—Saturdays, 7 to 10 p.m. Under Mr. Chaloner's direction.

CHARING CROSS HOSPITAL AND SCHOOL OF MEDICINE.

WINTER SESSION.

Lecturer.—Mr. C. W. Heaton, F.C.S. *Demonstrator.*—T. Bolas, F.C.S. Monday, Thursday, and Friday, at 11. One Session, £5 5s.

The Laboratory is open daily.

SUMMER SESSION.

Practical Chemistry.—Mr. Heaton, F.C.S. *Demonstrator.*—T. Bolas, F.C.S. Monday and Friday. One Session, £2 2s.

Special Evening Classes. Advanced Chemistry, Tuesday and Thursday, at 7 p.m. Fee, £2 2s. per month.

CITY OF LONDON COLLEGE, LEADENHALL STREET, E.C.

The Annual Courses consist of three terms, each averaging ten Experimental Lectures. Fee, 5s. per term.

Subjects:—Junior Class, Chemistry—First year, Non-Metals; second year, Metals and (time permitting) Elements of Organic Chemistry. Senior Class, 7 to 8 p.m., Practical Analysis.

ST. GEORGE'S HOSPITAL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Dr. H. M. Noad, F.R.S. Tuesday, Thursday, and Saturday, at 11.30. One Course, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Dr. Noad, F.R.S. Monday, Wednesday, Thursday, and Friday, at 10. One Course, including the use of apparatus and materials, £4 4s.

Physiological Chemistry.—Demonstrator—Dr. Ralfe.

GUY'S HOSPITAL.

WINTER SESSION.

Lecturers.—Dr. Debus, F.R.S., and Dr. Stevenson. Tuesday, Thursday, and Saturday, at 11. One Course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Dr. Debus, F.R.S. Monday, Wednesday, and Friday, from 10 to 1. One Course, £4 4s.

Practical Instruction is also given in the Laboratory by Drs. Debus and Stevenson during the Winter Session.

KING'S COLLEGE.

Professor of Chemistry.—C. L. Bloxam, F.C.S.

Demonstrator.—W. N. Hartley, F.C.S.

Assistant Demonstrator.—J. M. Thompson, F.C.S.

I. For Students intending to devote themselves to Medicine, Pharmacy, or Scientific Chemistry, or to take a degree in Medicine or Science in the University of London. A Course of between sixty and seventy Lectures, by the Professor, commencing in October and terminating in March. Inorganic Chemistry, October till January. Organic Chemistry, February and March. On Monday, Wednesday, and Thursday, from 10.15 till 11.15. Fee, £8 8s. for the Course, or £11 11s. perpetual attendance.

II. For Students intending to devote themselves to Engineering, Manufacturing Chemistry, Mining, Scientific Chemistry, Commerce, Agriculture, Manufactures, Military Science, the Civil Service, and for those who are studying Chemistry for the sake of general information and as part of a liberal education. A Course of between fifty and sixty Lectures, by the Professor, carried on during the whole academical year. This Course is of such a character that Students may enter, without serious disadvantage, at the commencement of either of the College Terms. On Tuesday and Friday, from 10.20 till 11.20. Fee, £3 3s. a term, or £8 8s. for the year.

III. For Students who have any Examination in prospect, or who require general guidance in their Chemical studies. A Course of ten or twelve Lectures in each College Term, by the Assistant Demonstrator. On Saturday, from 11.15 till 12.15. Fee, £1 1s. for each term.

EVENING CLASSES.

For Students who are preparing for any Examination, or who require a general knowledge of Chemistry applicable to any pursuit.

A. A Course of about forty Lectures, by the Demonstrator, commencing in October and terminating in March. On Monday and Thursday evenings, from 7 till 8. Fee, £1 11s. 6d. for the Course.

B. A Summer Course of about ten Lectures, in April, May, and June. On Monday evening, from 6.30 till 7.30. Fee, £1 1s. for the Course.

PRACTICAL CHEMISTRY.

For the study of Chemical Analysis of Inorganic and Organic Substances, as far as it is required in most Examinations. This Course is also preliminary to the study of Practical Chemistry in general.

Each Student works independently in the Laboratory, which is open in October, November, December, January, February, March—On Tuesday evening, from 7 till 9 p.m. Fee, £2 2s. for the Course.

II. May, June, July—On Monday, Tuesday, Wednesday, and Thursday, from 10.15 till 12.15 a.m. Fee, £5 5s. for the Course.

III. Each College Term—On Tuesday and Friday, from 10.20 till 11.40. Fee, £4 4s. per Term.

LABORATORY OF ANALYTICAL AND EXPERIMENTAL CHEMISTRY.

For the study of all branches of Practical Chemistry.

Each Student works independently in the Laboratory, which is open during all College Terms, on every day (except Saturday) from 10 till 4, and on Saturday, from 10 till 1. Fees, Experimental and Analytical Chemistry—One month, £4 4s.; three months, £10 10s.; six months, £18 18s.; nine months, £26 5s.

LONDON HOSPITAL AND MEDICAL COLLEGE.

Lectures on Chemistry.—Henry Letheby, M.B., and C. Meymott Tidy, M.B. Monday, Wednesday, and Friday, at 10.30 a.m. One Session, £7 7s.

Practical Chemistry.—Dr. Letheby, M.B. Monday, Thursday, and Saturday, at 9 a.m. One Session, £3 3s.

MIDDLESEX HOSPITAL MEDICAL COLLEGE.

WINTER SESSION.

(Lectureship vacant). Monday, Thursday, and Friday, at 3; Saturday, at 11. One Session, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Monday and Thursday at 3; Friday, at 11.30. One Session, £3 3s.

ST. MARY'S HOSPITAL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Dr. C. R. A. Wright, F.C.S. Monday, Tuesday, Thursday, and Friday, at 9 a.m. £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. C. R. A. Wright, F.C.S.

Inorganic Course.—Arranged for the requirements of the London University Preliminary Scientific Examination. Tuesday, Friday, and Saturday, at 9 a.m. Fee, £3 3s.

Organic Course.—Arranged to meet the requirements of the London University First M.B. Examination. Tuesday and Friday at 10 a.m. £3 3s.

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NORTH LONDON SCHOOL OF CHEMISTRY AND PHARMACY.

54, KENTISH TOWN ROAD, N.W.

Conducted by Mr. J. C. Braithwaite.

The session 1875-76 commences on the 1st of October, when the Laboratory will be open for Instruction in Practical Chemistry.

The classes for Chemistry, Materia Medica, Botany, and Latin meet at 8 p.m. Fee to either class, 10s. 6d. per month.

As each pupil works independently, he can enter at any period to either Classes or Laboratory.

ROYAL POLYTECHNIC INSTITUTION,

309, REGENT STREET, W.

Scientific Department under the direction of Professor Edward V. Gardner, F.A.S., M.S.A., assisted by an efficient staff of Masters and Assistants.

Classes on Heat, Chemistry, Galvanism, Magnetism, and Electricity commence in October; they are adapted to meet the wants of gentlemen preparing for Matriculation, Woolwich, Sandhurst, or Direct Commissions.

The Chemical Laboratory is excellently fitted, and gentlemen can pursue their studies privately under the supervision of Professor Gardner. The Laboratory is open from 10 to 5 daily, and each evening from 7 to 10.

The Class and Experimental Rooms are fitted for the study of Photography, Steam, and the different branches of Physics.

The Fees for practical study are arranged according to the time occupied.

Private Rooms.—A new feature in the arrangements for scientific study at the Polytechnic is the setting apart of rooms especially fitted for the pursuit of experiments and investigations of a private nature. These can be secured, with or without professional assistance, by those who need such advantages.

ROYAL VETERINARY COLLEGE, CAMDEN TOWN.

Professor of Chemistry.—Mr. R. V. Tuson.

ST. THOMAS'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. J. Bernays. Wednesday, Thursday, and Friday, at 9. One Course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. J. Bernays. Tuesday and Thursday, 10 to 12; Friday, 11; Saturday, 10 to 1. One Course, £3 3s.

ST. MARGARET'S TECHNICAL DAY SCHOOL FOR BOYS,

NEAR ARTILLERY ROW, VICTORIA STREET, WESTMINSTER.

Head Master.—Mr. Robert E. H. Goffin, F.C.S.

The object of the School is to supply a sound, practical Education, with especial regard to technical training, for boys from the age of seven years and upwards.

The School will be open to all boys on payment, in advance, of an entrance fee of 2s. 6d., and a tuition fee of 10s. per quarter.

Numerous Exhibitions are reserved for boys who have been for three years at least at any Public Elementary School or Schools in the Parishes of St. Margaret and St. John, Westminster, or the Parish of St. Luke, Chelsea, and have passed the Government Inspector's Examination in the standard suitable to their age and standing.

There are nine Senior Scholarships of £5 per ann., tenable for two years, and six junior of £3 per ann., tenable for two years, in the School.

There are also classes in Chemistry, Physics, &c., for Teachers during the winter months.

The Course of Education includes Mathematics; Theoretical and Applied Mechanics; Acoustics, Light, and Heat; Inorganic Chemistry; Electricity and Magnetism; Practical Solid Geometry; Physical Geography; Animal Physiology; Steam and Steam Engines.

SCHOOL OF PHARMACY OF THE PHARMACEUTICAL SOCIETY OF GREAT BRITAIN,

17, BLOOMSBURY SQUARE.

The School opens on Monday, the 4th of October.

Lectures on Chemistry and Pharmacy, by Professor Redwood, on Monday, Tuesday, and Wednesday mornings, from 9 till half-past 10 o'clock, throughout the Session.

Lectures on Botany and Materia Medica, by Professor Bentley, on Thursday, Friday, and Saturday mornings at 9 o'clock, including a Course on Systematic and Practical Botany at the Gardens of the Royal Botanic Society's Gardens in the Regent's Park.

The Laboratories for practical instruction in Chemistry as applied to Pharmacy, &c., under the direction of Professor Attfield, will be open daily throughout the Session.

SCIENCE AND ART DEPARTMENT OF THE COMMITTEE OF COUNCIL ON EDUCATION, SOUTH KENSINGTON,

AND

ROYAL SCHOOL OF MINES, JERMYN STREET.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom. The object of the grant is to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The assistance granted by the Science and Art Department is in the form of—1. Public Examinations, in which Queen's Medals and Queen Prizes are awarded, held at all places on complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

The following Courses of Lectures, Demonstrations, and Practical Laboratory instruction are given at South Kensington:—

Chemistry, by Professor Frankland, D.C.L., F.R.S, A Course of Forty Lectures on Mineral Chemistry, commencing October 4, 1875. A Course of Thirty Lectures on Organic Chemistry, commencing January 19, 1876. Fees—Lectures on Mineral Chemistry, £4; Lectures on Organic Chemistry, £3; together, £6.

Chemical Laboratories.—The Laboratories for instruction in chemical manipulation, in qualitative and quantitative analysis, the technical application of analysis, and in the method of performing chemical researches, are under the direction of Dr. Frankland, and will be opened on Friday, October 1, 1875. The Laboratories at South Kensington Museum are now used for the instruction of the Pupils of the Royal School of Mines.

The charge for instruction in the Chemical Laboratory is £12 for three months, £9 for two months, and £5 for one month.

Physics, by Professor Frederick Guthrie, F.R.S. The Course will consist of about Sixty Lectures, with Laboratory work on the subject of the Lectures (see page 124). The Course will commence on October 4, 1875. Fee for Lectures and Laboratory work, £10.

Metallurgy, by Dr. Percy, F.R.S. The course will consist of about Fifty Lectures, commencing on October 11, 1875.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy, especially in Assaying. The nature of this instruction will be adapted to the special requirements of the Student. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c.; and the examination of ores and metallurgical products.

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The ability of the Student to make trustworthy assays is in every case thoroughly tested; and no certificate of competency is given to a Student who has not furnished satisfactory proof that he is able to obtain accurate results.

The charge for instruction in the Metallurgical Laboratory is £15 for three months, £12 for two months, and £7 for one month.

Besides the Students entering for the Associateship of the Royal School of Mines, and Teachers in Training, only such a limited number of occasional public Students will be admitted as can be accommodated. Letters with respect to the foregoing Courses should be addressed to the Secretary, Science and Art Depattment, South Kensington, London, S.W.

Lectures to Working Men.—Short Courses of Lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as to illustrate, within a period of two years, the principal subjects taught at the institution. Those for the ensuing Session include Physics, Natural History, and Metallurgy.

SOUTH LONDON SCHOOL OF CHEMISTRY, 325, KENNINGTON ROAD.

The subjects taught include Chemistry, Botany, Physics, Latin, Materia Medica, and Pharmacy. All apparatus and chemicals are provided for the students. There is also a special department for Instruction in Food Analysis at the Central Public Laboratory, Kennington Cross, under the personal supervision of the Director, who has been appointed Public Analyst. The Chemical portion of the Course consists of Ten Months' Lectures on Inorganic and Organic Chemistry. The Lecturer is Dr. John Muter, F.C.S., and the hour is 10 a.m. daily. The Laboratory is open daily for Practical Instruction from 10 till 4. Secretary, Mr. W. Baxter.

The Session commences on September 15th.

UNIVERSITY COLLEGE.

Chemistry.—Professor Williamson, Ph.D., F.R.S.
Assistant Professor.—Charles Graham, D.Sc.

A. GENERAL COURSE.

Lectures daily (except Saturday) from 11 to 12 a.m., up to the last week in March.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the whole Course of Lectures, £7 7s.; for the First or Second Half Course separately, £4 4s.; for the Second Half, when the first has been taken, £3 3s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise Class, £2 2s.

The instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of Exercises and personal instruction on the subject of the Lectures by the Assistant Professor.

A weekly *viva voce* examination is held during the First Half Course and the commencement of the Second Half Course.

Organic Chemistry commences in the second week in February, and occupies five Lectures weekly till about the end of March.

Teachers of Chemistry are trained in the theory and practice of their profession. A two years' Course is absolutely requisite for this purpose; but Students will with advantage devote a longer period to it.

The first year is occupied with attendance on the Courses of Chemistry and of Analytical Chemistry. In the second year the Student again attends the Course of Chemistry, and is entrusted with teaching work in conjunction with the Tutors of the Class. At the same time he continues to work in the Laboratory at analysis and original research.

In order to qualify themselves for rising to the higher ranks of the Profession, gentlemen remain for a further period, in which case they may obtain remunerative work in teaching through the recommendation of the Professor.

B.—ANALYTICAL AND PRACTICAL CHEMISTRY.

I. *Birkbeck Laboratory.*

The Laboratory and offices are open daily from 9 a.m. to 4 p.m., from the 2nd of October until the end of July, with a short recess at Christmas and at Easter. Saturday, from 9 to 2.

Fees, for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials.

II. *Summer Courses.*

1. *Elementary Course.*—About forty Lessons, of one hour each, on Tuesday, Wednesday, Thursday, and Friday, from 11 to 12, commencing in the first week of May.

Fees, including the cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

2. *Senior Course.*—This Course consists of twenty Lessons of two hours each, on Mondays and Saturdays, from 10 to 12, commencing in the first week in May.

Fees, including cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

C.—SUMMER MATRICULATION COURSE.

This Course includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Course consists of about twenty lessons in Practical Chemistry, and of an equal number of oral lessons. These lessons will begin on Tuesday, April 25, 1876, at 11 a.m.

The class will meet on Tuesdays, Wednesdays, Thursdays, and Fridays, from 11 to 12; and some other meetings will be announced when the class has assembled.

Fee, including cost of materials and apparatus, £4 4s.

WESTMINSTER HOSPITAL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Dr. A. Dupré, F.R.S., F.C.S. Wednesday, Thursday, and Friday, at 3 p.m. One Course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. Dupré, F.R.S, F.C.S. Monday, Wednesday, and Friday, at 10 a.m. One Course, £3 3s.

Special instruction can be obtained in the laboratory by gentlemen, whether pupils of the school or not, on application to the Lecturer. This will enable Students to become practically acquainted with the analysis of water, the detection of adulteration, and other chemical processes, a knowledge of which is necessary for an Officer of Health or a Public Analyst.

BIRMINGHAM.—MIDLAND INSTITUTE.

Lecturer on Chemistry.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.

Practical Chemistry.—Mr. C. J. Woodward, B.Sc. Friday, 7 to 10; and Saturday, 3 to 6 p.m.

BIRMINGHAM.—QUEEN'S COLLEGE.

WINTER SESSION.

Professors of Chemistry.—Alfred Hill, M.D., and A. G. Anderson. Tuesday, Thursday, and Friday, at 12.

SUMMER SESSION.

Practical Chemistry.—Professor A. G. Anderson. Thursday and Friday, at 2 p.m.

BRISTOL.—BRISTOL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Mr. Thomas Coomber, F.C.S. Monday, Wednesday, and Friday, at 8.30. One Course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. T. Coomber, F.C.S. Daily, except Saturday, at 8 a.m. One Course, £3 3s.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.
Jacksonian Professor of Natural History.—J. Dewar, M.A.
Demonstrator.—J. W. Hicks, M.A.

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LECTURES IN MICHAELMAS TERM.

Chemistry, general principles, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12.

Spectroscopic Analysis, by the Professor.

Dissociation, and Thermal Chemistry, by the Jacksonian Professor, Tuesdays and Thursdays, at 12.

Practical Chemistry, by the Demonstrator, daily.

Principles of Qualitative Analysis, by Mr. Main, at St. John's College.

Volumetric Analysis, by Mr. Apjohn, at Gonville and Caius College.

LECTURES IN LENT TERM.

Chemistry, general principles continued, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12.

Organic Chemistry, by the Jacksonian Professor, Tuesdays, Thursdays, and Saturdays, at 12.

Analysis, by the Professor or Demonstrator, daily.

Elementary Chemistry, by Mr. Main, at St. John's College.

Non-Metallic Elements, by Mr. Apjohn, at Gonville and Caius College.

LECTURES IN EASTER TERM.

History of Chemical Philosophy, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12.

Laboratory Instruction in Chemical research, by the Jacksonian Professor.

Analysis, daily.

Elementary Inorganic Chemistry, by the Demonstrator.

Chemistry, continued, by Mr. Main, at St. John's College.

Organic Analysis, and Elementary Organic Chemistry, by Mr. Apjohn, Gonville and Caius College.

The Chemical Laboratory of the University is open daily, from 10 a.m. until 6 p.m., for the use of Students, under the direction of the Professor. The Demonstrator or Assistant Demonstrator attends there daily to give instruction in manipulation.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

CHEMICAL DEPARTMENT.

Professor of Chemistry.—A. H. Church, M. A. Oxon.

Assistant.—R. C. Woodcock, F.C.S.

The Collegiate year is divided into two Sessions, one beginning in February and ending in June, the other beginning in August, dividing in October, and ending in December.

During each Session the following Courses are given:—

36 Lectures on Inorganic Chemistry.

36 Lectures on Organic Chemistry.

36 Lectures on Agricultural Chemistry.

36 Laboratory Lessons in Chemical Manipulation.

36 Laboratory Lessons in Qualitative Analysis.

36 Laboratory Lessons in Quantitative Analysis.

The College Laboratory is open every day, except Saturday, from 9 a.m. till 5 p.m.

Advanced Students have the privilege of working at all times when the Laboratory is not occupied by other classes.

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.

Chemistry and Practical Chemistry.—J. Campbell Brown, D.Sc. Lond., F.C.S.

The first half of the Course, to Christmas, includes all the branches of Chemistry required for the Matriculation Examination of the University of London.

The Course consists of 100 Lectures. Fee, £5 5s.

Technological and other non-medical Students may take out any of the divisions separately—Fee, £1 1s.; but no certificates will be given until the whole Course has been attended.

Practical Chemistry.—The Laboratories accommodate eighty working Students. Fees, from £1 1s. to £4 4s. per month.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY,

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by Mr. A. Norman Tate.

Hours of attendance, 9.30 a.m. to 5 p.m. (Saturdays, 9.30 a.m. to 1 p.m.).

Fees—Three months, £15 15s.; six months, £26 6s.; twelve months, £52 10s.

The Laboratory is also open from October to end of April two evenings per week for Lectures and practical work.

LIVERPOOL SCIENCE AND ART CLASSES.

Chairman.—Mr. James Samuelson.

Honorary Secretary.—Mr. Michael Fitzpatrick.

These Classes will commence on September 22nd.

Inorganic Chemistry, Elementary Course, at Queen's Road Board Schools.

Lecturer.—Mr. Hugh Hughes.

Lectures, Tuesdays, 7 to 8 p.m.; Laboratory Practice, 8 to 10 p.m.

Inorganic Chemistry, Advanced Course, at 7 and 9, Hackin's Hey.

Lecturer.—Mr. Norman Tate.

Lectures, Fridays, 7 to 8 p.m.; Practice in Qualitative and Quantitative Analysis, 8 to 10 p.m.

COLLEGE OF CHEMISTRY, LIVERPOOL.

Principal.—Mr. Martin Murphy, F.C.S., Professor of Chemistry.

The Course of instruction given in the College of Chemistry comprises the teaching of Chemistry as a science, and the general application of chemical knowledge; also the teaching of the principles of those branches of physics which are allied with Chemistry, such as light, heat, electricity, &c.

The Student's Laboratories are open throughout the year. Hours of attendance—From 10 a.m. to 5 p.m. daily. Fees—10 guineas per quarter of three months, or 35 guineas per annum, payable in advance.

Medical and Pharmaceutical Students are admitted for one hour per day. Fee for three months, £2 2s.

A Course of Lectures will be delivered to the Students during the winter months. There will also be Evening Classes.

Certificates of attendance recognised by the University and Apothecaries' Hall of London, and Apothecaries' Hall of Ireland.

LEEDS MECHANICS' INSTITUTION AND LITERARY SOCIETY'S LABORATORY.

Chemical Classes and Laboratory for Instruction in Elementary, Practical, and Analytical Chemistry, commence on Friday, October 1, at 8 p.m.

Lecturer.—Mr. George Ward, F.C.S., with Assistants.

YORKSHIRE COLLEGE OF SCIENCE, LEEDS.

Professor of Chemistry.—T. E. Thorpe, Ph.D., F.R.S.E., F.C.S.

Lecture Courses.

1. General Course on Inorganic and Organic Chemistry—Monday, Tuesday, Wednesday, and Thursday, at 4 p.m., from October to the end of March. Fee for the Course, £4 4s.

2. Lectures on Laboratory Practice and Chemical Calculations—Thursday, at 9.30 a.m., from October to the end of March. Fee, £1 1s.

3. Lectures on the Chemistry of the Non-Metals—Saturday, at 12 a.m., from October to March. Fee, 10s. 6d. This class is chiefly intended for Schoolmasters and their Assistants: it will not be held unless a sufficient number enter.

4. Lectures on Chemical Technology. A course

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eight lectures on the *Chemistry of Tanning* will probably be given during the summer.

Laboratory Courses.

Professor T. E. Thorpe, Ph.D., F.R.S.E.

The College Laboratory will be open daily from 9 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturdays, when it will close at 1 p.m.

Fees for the Session—Students working six days per week, £17 17s.; four, £13 13s.; three, £11 11s.; two, £8 8s.; one, £4 4s.

Special fees for shorter periods—For six months, six days per week, £13 13s.: five, £11 11s.; four, £9 9s.; three, £7 7s.; two, £5 5s.; one month, £3 3s.

Schoolmaster's Class on Practical Chemistry, Saturday mornings, from 9 to 12, from October to March. Fee, £1 11s. 6d.

Practical Chemistry for Medical Students.—On Monday and Wednesday, from 9 to 11 a.m., from May to the end of July.

MANCHESTER GRAMMAR SCHOOL.

CHEMICAL DEPARTMENT.

Master.—Francis Jones, F.C.S., F.R.S.E.

Assistant Master.—R. L. Taylor, F.C.S.

Instruction is given in Inorganic Chemistry, Organic Chemistry, Metallurgy, and Analytical Chemistry, Botany, Geology, and Mineralogy. There is a lecture-room and second Laboratory, affording accommodation for seventy-two Students.

MANCHESTER MECHANICS' INSTITUTION.

Inorganic Chemistry.

Lecturer.—M. A. Watts, M.A. Friday evening, 7.15 to 9.13.

Practical Chemistry.

Friday evening, 8.15 to 9.15. This class will be open to those Students only who attend a lecture course also.

COLLEGE OF PHYSICAL SCIENCE, NEWCASTLE.

(IN CONNECTION WITH THE UNIVERSITY OF DURHAM.)

Chemistry.—Professor—A. Freire-Marreco, M.A. *Demonstrator*—J. T. Dunn, Assoc. Phys. Science.

Practical Chemistry.—The Laboratory is open from 10 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturdays, when it closes at 1 p.m. *Laboratory Fees.*—Students working six days per week, £5 5s. per term; alternate days, £3 3s.; one day per week, £1 1s.

Arrangements for Laboratory work in the evening and during vacation will be made.

Courses of Study.—Students will be distinguished into Regular and Occasional. Regular Students will be required to follow such a course of study in the subjects professed in the College as will enable them to pass the Examinations for the title of Associate in Physical Science. Occasional Students will attend such classes as they may elect.

The Session will commence on the 5th of October, 1875.

Evening Classes.—Professor A. Freire-Marreco, M.A. Twelve Lectures on Inorganic Chemistry. Mondays, at 7.45, commencing November 1, 1875.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—Dr. Odling, F.R.S.

Demonstrator.—E. Madan, M.A.

A commodious Laboratory is attached to the New Museum.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other colleges, by competitive examination in Natural Science.

OWEN'S COLLEGE, MANCHESTER.

Professor and Director of the Chemical Laboratories.—H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Professor of Organic Chemistry.—C. Schorlemmer, F.R.S.

Demonstrators and Assistant Lecturers.—Mr. W. C. Williams, F.C.S., and Mr. M. M. Pattison Muir, F.R.S.E.

Hon. Demonstrators.—Mr. Thomas Carnelley, B.Sc., and Mr. Oswald Wilkinson.

Lecture Courses.

Systematic Chemistry.—Junior Class—Tuesday, Thursday, and Saturday, from 9.30 to 10.30 a.m., during Michaelmas and Lent Terms. Comprising—(1) The laws of Chemical Combination; (2) a description of the physical and chemical properties and the mode of preparation of the Non-Metallic Elements and of their compounds.

Senior Class.—Monday, Wednesday, and Friday, from 9.30 to 10.30 a.m., during the Michaelmas and Lent Terms, comprising—(1) The Chemistry of the Metals and of their most important compounds; (2) Organic Chemistry.

The instruction in Systematic Chemistry is given by means (*a*) of Experimental Lectures and (*b*) of Tutorial Classes.

Fee—For each Class, £2 12s. 6d.; for both Classes, £4 14s. 6d.

A Tutorial Class, meeting in Sections, will also be held, which all members of the Junior and Senior Classes will be required to attend, unless specially exempted by the Principal and the Professor. Extra fee for this Class, 10s. 6d. This fee is not included in the composition fees payable by regular Students.

Organic Chemistry.—Professor C. Schorlemmer, F.R.S. Tuesday, Thursday, and Friday, from 2.30 to 3.30 p.m.

The subject of this Course is the Chemistry of the Carbon Compounds, wherein the branch of Organic Chemistry is more fully and completely treated than in the general Course in Systematic Chemistry.

Fee, £3 10s.

Technological Chemistry.—Monday and Wednesday, from 2.30 to 3.30 p.m.

The chemical principles involved in the most important Chemical Manufactures will chiefly be considered in this Course. The subject will be discussed as follows:—

1. Twenty Lectures on Water and Air and the Chemistry of the Alkali Manufacture, by Professor Roscoe.

2. Twenty Lectures on the Chemistry of Colouring Matter, Dyeing and Calico Printing, by Professor Schorlemmer.

Students attending this Class must be acquainted with the principles of chemical science.

Fee, £1 11s. 6d.

Chemical Philosophy.—Professor C. Schorlemmer, F.R.S. Saturday, from 9.30 to 10.30 a.m.

Sketch of the History of Chemistry; Development of Modern Chemistry; Chemical Laws and Theories; Relation of Chemistry to Physics.

Fee, £1 11s. 6d.

Analytical Chemistry.—Mr. W. C. Williams, F.C.S. Thursday, from 10.30 to 11.30 a.m.

This Course will treat of the methods of Qualitative and Quantitative Analysis, and is intended to supplement the instruction in Practical Chemistry.

Fee, £1 11s. 6d.

Analytical and Practical Chemistry.

LABORATORY COURSES.

The Chemical Laboratories will be open for Students daily from 9.30 a.m. until 4.30 p.m., except on Saturdays, when they will be closed at 12.30 p.m.

Regular Students, or those preparing for Degrees, may enter for two days a week at a fee of £9 9s. All other Students will be required to enter according to the following scale, and those working in the Quantitative Laboratory will be required to enter for not less than four days per week.

Fees for the Session—For six days per week, £21; for four days per week, £17 17s.; for three days per week, £13 13s. Students entering the Laboratory Class at or after Christmas will be charged two-thirds of the fees for the whole Session.

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Fees for shorter periods—For six months, £17 17s.; for five months, £15 15s.; for four months, £13 13s.; for three months, £10 10s.; for two months, £7 7s.; for one month, £4 4s. Students entering under this scale are entitled to work on every day during the week.

QUEENWOOD COLLEGE.
NEAR STOCKBRIDGE, HANTS.

The Science Department of the above College is under the direction of E. W. Prevost, Ph.D., F.C.S., F.R.S.E. Lectures are delivered during term time on Chemistry and Natural Philosophy, and a well-appointed Chemical Laboratory is used by all but the youngest pupils. The Course of Instruction is well suited to meet the requirements of the London University and College of Surgeons Examinations.

Principal.—C. Willmore.

BOROUGH ANALYST'S LABORATORY,
1 and 3, SURREY STREET, SHEFFIELD.

Mr. A. H. Allen, F.C.S., delivers a Course of Thirty Lectures on Inorganic Chemistry and Metallurgy. Day and Evening Classes for the practice of Analytical Chemistry and Assaying.

SHEFFIELD SCHOOL OF MEDICINE.

A Course of Forty-five Lectures on Inorganic and Organic Chemistry will be delivered during the Winter Session, by A. H. Allen, F.C.S.

The Summer Course of Practical Chemistry is conducted by Mr. Allen.

SCOTLAND.

UNIVERSITY OF ABERDEEN.

Professor of Chemistry.—J. S. Brazier.

ABERDEEN SCHOOL OF SCIENCE AND ART MECHANICS' INSTITUTION.

Subject.—Chemistry, with Laboratory practice.

Teacher.—Thomas Jamieson, F.C.S.

Fees, 10s. per Session, Apparatus, &c., extra. Session —November to April inclusive.

ANDERSONIAN UNIVERSITY, GLASGOW.
DEPARTMENT OF SCIENTIFIC CHEMISTRY.

Professor.—W. Dittmar, F.R.S.E., &c.

Senior Assistant.—R. W. Emerson MacIvor, F.C.S.

Junior Assistant.—W. S. Curphey.

A Course of One Hundred Lectures on Inorganic and Organic Chemistry will be commenced at the end of October. Fee, £2 12s. 6d.

The Laboratory will open at the beginning of November. Fee for the Winter Session (inclusive of gas, reagents, &c.), £12 12s.

UNIVERSITY OF EDINBURGH.

Professor of Chemistry.—Dr. A. Crum Brown, F.R.S.E.

SCHOOL OF MEDICINE, EDINBURGH.

Lecturer on Chemistry.—Dr. Stevenson Macadam, F.R.S.E.

The Courses of Instruction in Chemistry include its applications to Medicine, Agriculture, and the Industrial Arts; and they qualify for the University of Edinburgh and other Universities, the Royal Colleges of Physicians and Surgeons, the Navy, Army, and Indian Medical Service, and the other Medical and Public Boards.

GLASGOW MECHANICS' INSTITUTION.

Professor of Chemistry.—Mr. R. R. Tatlock, F.R.S.E., F.C.S.

SCHOOL OF CHEMISTRY.
138, BATH STREET, GLASGOW.

Dr. Wallace, Mr. Tatlock, and Dr Clark.

Lectures on Inorganic and Organic Chemistry and Laboratory Instruction in Analytical and Practical Chemistry.

CHEMICAL LABORATORY AND CLASS ROOMS.
144, WEST REGENT STREET, GLASGOW.

Conducted by Dr. Milne.

The Laboratory is open daily from 10 to 4 (Saturdays excepted), for Instruction in Practical and Analytical Chemistry.

The Practical Evening Classes for Instruction in Analysis and Testing will meet on Tuesdays and Thursdays, from 7 p.m. till 9 p.m., commencing November 2.

ANALYTICAL LABORATORY,
88, HOPE STREET, GLASGOW.
Dr. A. T. MACHATTIE, F.C.S.

The Instructions in Analytical and Practical Chemistry and Practical Medical Chemistry are conducted daily from 10 a.m. till 5 p.m., under the personal superintendence of Dr. Machattie.

Attendance qualifies for Examination by the faculty of Physicians and Surgeons, Glasgow; the Royal Colleges of Physicians and Surgeons; and other Public Boards.

IRELAND.

QUEEN'S COLLEGE, BELFAST.

Professor of Chemistry.—Dr. Andrews, F.R.S., &c.

TRINITY COLLEGE, DUBLIN.

Professor of Chemistry.—Dr. J. Emerson Reynolds.

ROYAL COLLEGE OF SURGEONS IN IRELAND

Professor of Chemistry and Hygiene.—Charles A. Cameron, M.D., F.R.C.S.I.

Principal Assistant.—Edwin Lapper, F.C.S.

Fee for course of Winter Lectures, £3 3s. Fee for three months' course of Instruction in Laboratory, £3 3s. Fee for six months' special Instruction in Sanitary Chemistry, £10 10s.

An additional Laboratory for Students has recently been built.

GOVERNMENT AGRICULTURAL INSTITUTION, GLASNEVIN, CO. DUBLIN.

Fifty Lectures on Agricultural Chemistry and Geology are annually delivered in this institution by Dr. Charles A. Cameron.

ROYAL COLLEGE OF SCIENCE FOR IRELAND,
STEPHEN'S GREEN, DUBLIN.

Professor of Practical and Theoretical Chemistry.—R. Galloway, F.C.S.

Professor of Experimental Physics.—W. F. Barrett, F.R.S.E., F.C.S.

The Chemical and Metallurgical Laboratories, under the direction of Mr. Galloway, are open every week-day during the Session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical Research. Fee, for the Session of nine months, £12; or for three months, £5; or for one month, £2.

There are four Royal Scholarships of the value of £50 each yearly, with Free Education, including Laboratory Instruction, tenable for two years; two become vacant each year; they are given to Students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with free Education, including Laboratory Instruction, tenable for three years; three become vacant each year.

A Diploma of Associate of the College is granted at the end of the three years' course.

The Session commences on Monday, October 4th.

QUEEN'S COLLEGE, GALWAY.

Professor of Chemistry.—Dr. T. H. Rowney.

A Laboratory for Practical Instruction is attached to all the Queen's Colleges. The usual Practical Course for the Medical Boards is given in the summer.

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INSTRUCTION IN PHYSICS AT SOUTH KENSINGTON.

The practical instruction now imparted in the physical laboratories at South Kensington is of a most useful and comprehensive character. We are indebted to Dr. Guthrie for the following notes which were used during the last session; they will, we are convinced, prove of value to both teachers and students. We have omitted the notes on electricity and magnetism as they have already appeared in *The Electrical News and Telegraphic Reporter* for September 9.

In sending the notes Dr. Guthrie wrote as follows:—

"*To the Editor of the Chemical News.*

"Sir,—The accompanying notes were used by the Laboratory Students in Physics during the three months' course in the session 1874—75. For the science teachers, the courses on Light and Heat are somewhat extended, for we were able in the summer to devote three clear weeks to each of these subjects. I hope next year to be able to extend Molecular Physics, Sound, Electricity, and Magnetism in a similar way.

"This instruction has grown up during the last three or four years. Four years ago Prof. Goodeve and I drew up a 'Sketch of Experiments' (chiefly from our lecture notes) for distribution amongst science teachers. When I undertook to give practical instruction in physics to science teachers, students of the School of Mines, and teachers in training, it was found necessary to give rather more minute instructions, especially concerning the making of apparatus. The gentlemen who have from time to time been good enough to give me the advantage of their co-operation in conducting the practical courses are Prof. Barrett, Prof. Foster, Prof. Goodeve, Mr. Haddon, Prof. Pedler, Dr. Pike, Prof. M. Simpson, Mr. Wilson, and Dr. Wormell. I will answer for it that they all, as readily as I, put these notes unreservedly in your hands if you think they will be useful to your readers.—I am, &c.,

Frederick Guthrie.

Science Schools, South Kensington,
August 17, 1875.

Heat.

Make a differential thermometer.

Bend glass tube, about 2 ft. long, six times at right angles thus—

Fill middle portion with coloured alcohol to stand about 2 ins. high in each stem. Fit small flasks on ends of tubes with corks, making joints air-tight with sealing wax if necessary. Mount on wood stand, and affix paper scale. (See below.)

Ascertain range of differential thermometer, and graduate in Centigrade degrees.

Alcohol in thermometer tube being at same level on both sides, mark as zero on scale. Immerse both bulbs equally in vessels of water. Increase temperature of water in one of the vessels until alcohol column has risen to greatest possible height on one side; mark this point on scale. Ascertain difference of temperature between the vessels, and divide range into same number of degrees and decimal parts of degrees.

Make an alcohol thermometer.

Blow strong bulb about ¾-inch diameter on end of thermometer-tube; allow to cool. Gently heat bulb in flame, and immerse open end of tube in coloured alcohol, which will enter bulb as it cools. Repeat this if necessary until very little air is left in bulb. Shake this air up into open end of stem. When bulb at ordinary temperature, raise it 10° or 20° by immersion in hot water, observing movement of liquid in tube: so ascertain range of instrument, and adjust quantity of liquid accordingly. Now cool bulb with freezing-mixture. When liquid at lowest point seal open end of tube in blowpipe flame.

Graduate alcohol thermometer.

Immerse thermometer in melting ice, and mark zero thus obtained on the tube with ink or black varnish. Mark also intervals of 10° upwards by comparison with mercurial thermometer placed in water at required temperatures. Mount thermometer on wood, and attach paper scale.

Make bulb for determining expansions.

Blow *strong* bulb at least 1 inch diameter on stout thermometer-tube. Cut off tube 3 inches from bulb.

Determine mean coefficient of expansion of glass of thermometer tubing for 50° C. above the temperature of the day.

Weigh bulb-tube (No. 1) full of mercury at temperatures t and T, and so obtain coefficient of apparent expansion of mercury (=B). (See next experiment.) Then, assuming coefficient of real expansion of mercury as 0·00018 (=C), C − B = mean coefficient of glass.

Determine mean coefficients of absolute expansion of water and alcohol between temperature of the day and 50° C. above.

Weigh bulb-tube filled with liquid at temperatures t and T. Calling weight of liquid at t W, and loss of weight at T w, the coefficient of apparent expansion is

$$\frac{w}{W-w}$$

The real expansion is obtained by adding to this the coefficient of expansion of the glass.

Make apparatus to illustrate method of measuring absolute expansion of a liquid.

At 12 inches from one end of small glass tube 30 inches long reduce considerably bore of tube by softening in blowpipe flame. Bend tube at right angles about an inch below contraction. Bend again at right angles from first elbow. Cut tube, if necessary, so as to make limbs of equal length. Coat each limb of tube with thin layer of bees'-wax containing a little turpentine. Fasten tube down on table by means of bees'-wax. Similarly fasten down steel millimetre scale of distance of 3 feet from tube, and so that longest axes of scale and one limb are in same straight line. Make fine hole through each end of wood rod 3 feet long, and fix in each hole a large needle, so that point projects about half an inch. Placing one of the points successively in each division of the steel scale, scratch corresponding divisions through the wax on glass with other point, making each fifth and tenth division of suitable length. Shift scale, and similarly graduate other limb. Brush with diluted fluoric acid, and leave for about half-an-hour. Take up tube, wash off acid with plenty of water, then remove wax. Upon each limb fix outer tube about ¾-inch diameter and 10 inches long by means of corks at each end. Make four elbows of small quill tube, and fit one through each cork. The contraction on one limb should be just within cork.

Determine coefficients of absolute expansion of mercury and of water with above apparatus.

Fix the apparatus vertically in clip, and fill inner tube with the liquid so that level of liquid is just above cork in each limb. Pass steam through outer tube of limb with contraction until liquid in tube within is at 100° C. Pass water of known temperature through outer tube on other limb. Note length of liquid column in each limb. Calling length in cold limb H, length in hot limb h, and difference of temperature t, the coefficient of expansion for 1° is—

$$\frac{h-H}{Ht}$$

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Make liquid conductivity cones.

Make two tin-plate cones, bases 2½ inches diameter and 3 inches high, with tubular necks 1 inch long ½ inch in diameter. On necks fit corks. Made wood support, consisting of an upright piece 8 in. × 2 in. × ⅜ in., to which are fixed at right angles, two other similar pieces 3½ inches long. Make holes in cross pieces to receive corks, so that bases of cones are immediately opposite each other. In neck of one cone fix cork, having through it a glass quill tube 30 inches long, lower end of which, when in use, dips in coloured liquid; lower cone and tube acting as an air thermometer. Fit with paper scale.

Compare with above apparatus conductivities of water, alcohol, turpentine.

Fix apparatus on edge of table. Heat lower cone slightly, so that when it cools, liquid will rise in tube to within about 6 inches of neck. Place between bases of cones a disc of known thickness (about 2 m.m.) Remove disc and introduce, by means of a pipette, the liquid to be examined, so that it completely fills the space between the cones. Note height of liquid in tube. Pour into upper cone water at known temperature (about 20° C. above that of room). Note depression of index column at end of one minute. Repeat experiment with other liquids, using in each case same volume of warm water at same temperature.

Make and use a Faraday's convection apparatus.

Fit large test-tube with cork, through which pass and fix two quill-tubes, one of which goes nearly to bottom of test-tube, the other terminating immediately below cork. Fit piece of glass tube, 6 inches long and about same diameter as test-tube, with cork at one end; through this cork pass and fix upper ends of quill-tubes, the tube which goes to the bottom of test-tube terminating just above cork, the other going to within an inch of the top. The two vessels should be about six inches apart, the small tubes may be straight, but are better if bent so as to give liquid a longer path. Fill completely lower vessel with coloured water, tubes and upper one with clear water. Gently warm lower vessel, when water will circulate.

Make and use apparatus for illustrating principles of ventilation.

Make zinc hoop 1 inch broad to loosely fit bottom of large paraffin lamp chimney. Solder hoop on piece of sheet zinc 3 inches square. Solder stout pin to stand vertically on centre of zinc plate within hoop. Make T-shaped sheet tin diaphragm about 4 inches long, to fit loosely in upper part of chimney. Place short lighted candle on pin, put a little water within hoop and place chimney over. First use apparatus without diaphragm, when candle will go out. Repeat experiment with diaphragm, the candle will not now be extinguished, inward and outward air currents being established in chimney. The existence of these currents may be shown by means of smoky brown paper.

Determine specific heats of iron, copper, zinc, tin, lead.

Heat substances in boiling water to 100° C. Immerse quickly beneath surface of known weight of water at known temperature. Then specific heat of substance

$$= \frac{\text{weight of water} \times \text{its gain of temperature.}}{\text{weight of substance} \times \text{its loss of temperature.}}$$

Apply to above results correction for containing vessel.

Multiply weight of vessel by its specific heat, thus obtaining water value of vessel.

Note.—A piece of tinfoil, folded as for a filter and supported on cotton-wool in a beaker, or cardboard cylinder, forms an easily made and suitable vessel for taking specific heats.

Determine specific heats of turpentine and mercury.

Heat liquid to 80° or 90° C., pour into water and use formula given above.

Determine specific heats of alcohol and turpentine from specific heat of iron found.

Substitute the liquid for water. Divide specific heat of iron by result thus found.

Ascertain number or heat units required to fuse unit weight of ice.

Place known weight of ice in larger known weight of water heated to about 60° C. Note temperature as soon as ice is entirely melted. Knowing number of heat units lost by hot water, and number of heat units gained by melted ice in rising to final temperature, calculate number required to fuse the ice. Divide this result by weight of ice.

Determine number of heat units required to convert unit weight of water into steam.

Fit flask with perforated cork and glass delivery tube. Boil water in flask, and when all air is expelled conduct steam into known weight (W) of cold water at known temperature (t) until temperature of water rises to 100° C. When cool find increase of weight (w). Then the number of heat units required will be—

$$\frac{W\,(100-t)}{w}$$

Verify results obtained in No. 2.

Repeat the experiment, removing steam pipe when the temperature of the water has risen to 50° or 60° C. Proceed as before, but allow in calculation for the heat lost by the condensed steam in falling to the final temperature.

Make reflecting galvanometer for thermo-electric experiments.

Through piece of wood 5 in. by 2 in. by ⅜ in., at 1 in. from end, cut circular hole 1 inch diameter with centrebit, and at 3 inches from end cut another hole ⅜ inch diameter. Cut slot ⅜ inch wide, connecting the holes and continued to end of board. Fix board vertically on centre of wood block 4 inches square, slot being at the top. Make two circular coils, one inch internal diameter, each consisting of 50 turns, No. 20 covered copper wire. Make sheet zinc clips for fixing coils to board. Make U-shaped brass wire staple one inch wide, fitted with cork roller and fix over slot, so that one edge of cork is over centre of board. At one end of piece of aluminium or magnesium ribbon 2½ inches long make fine hole, on other end fix a circular disc of zinc foil ⅜ inch diameter. On this cement a strip of magnetised watch-spring ⅜ inch long. At a distance of 1⅜ inches from magnet fix on ribbon a similar magnet with poles reversed and carrying a silvered circular mirror of microscope glass ⅜ inch diameter. (See instructions for silvering glass.) Suspend ribbon by fine raw silk fibre from cork roller, adjusting height by means of latter until mirror and disc swing freely within their respective spaces. Fix wire coils on board, one on each side of upper hole. Solder together two ends of coils so that current may flow through both in the same direction. Solder two free ends to binding screws fixed on base board. Make cardboard cover for instrument with glass front. On centre of top fix a cork and in cork a vertical brass wire about 4 inches long. Attach small bar magnet about 3 inches long to a cork; through latter make hole so that, magnet being horizontal, it may slide upon vertical wire and control small magnets below.

Make a thermopile.

In block of wood 1½ by 1½ by ½ inch make 32 holes, size of wire given, arranged in four parallel rows, so as to form a square. Cut 16 straight pieces of German silver wire 1 inch long and 16 similar pieces of

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iron wire. Thrust wires through holes so as to project equally on each side; holes 1, 3, 5, &c., being filled with iron, and holes 2, 4, 6, &c., with German silver wire. Solder alternate ends of wires together so as to form a continuous series. Solder copper connecting wires to free ends.

Make apparatus for showing influence of surface on absorption.

Cut two circular tin-plate discs 6 inches diameter. To centre of each solder, at right angles, a small bar of bismuth. To other end of the bismuth bar solder short piece of covered copper wire. Make hole through a cork, place over bismuth bar and over cork solder tin-plate cover. Lead copper wire out through cork, taking care that it does not make contact with tin. Solder a covered copper wire 3 inches long to edge of each plate. Mount plates on wood stands. Black face of one plate, leaving the other bright. To use the apparatus, place the plates parallel, a foot or so apart, with their faces turned towards each other. Connect edges of plates by a wire and connect the wires leading from bismuth bars to reflecting galvanometer. Place a hot ball or flame exactly half way between the plates: in a few seconds the galvanometer will be deflected in such a direction as to indicate that the blackened plate has become more heated than the bright one.

Ascertain temperatures at which the following salts solidify with water as cryohydrates:—Nitrate of potassium, sulphate of copper, chloride of ammonium.

Make saturated solution of the salt in water and half fill small test-tube therewith. Place thermometer in solution and plunge the whole into freezing mixture of ice and salts. Note temperature at which solution solidifies.

Ascertain lowest temperatures to be got by mixing each of the above salts with crushed ice.

Surround small beaker with flannel or other non-conducting material. Mix within it one part, by weight, of the salt with about three parts of ice. Note, by thermometer, lowest temperature obtained.

For the same salt, the temperature of solidification as a cryohydrate and the lowest temperature obtainable by mixing it with ice are identical.

Light.

Verify the law of inverse squares.

Using candle flame, or small gas flame, as source of light, cast a shadow of a book or square of cardboard upon screen or wall at distance of 10 feet from the light. Measure object and measure shadow which it casts when placed at distances of $2\frac{1}{2}$, 3, $4\frac{1}{2}$, 5, $6\frac{3}{4}$, and 8 feet from source of light. Note these dimensions and ascertain if they agree with theory.

Compare illuminating powers of candle flames, gas burners, &c., by shadow test.

At a short distance in front of wall or screen, fix a vertical rod. Place one of the lights (A) at a measured distance (d) from the screen, so that it throws a shadow of rod. Place second light (B) in such a position that it throws another shadow of the rod very near to the first one, and at such a distance (D) from the screen that the two shadows are exactly equal in intensity. Then the illuminating power of A : illuminating power of B : : d^2 : D^2.

Repeat preceding experiments with Bunsen photometer, and compare results.

Place lights to be compared, one at each end of scale; move paper disc until grease spot is no longer distinguishable from surrounding paper. The illuminating powers of the lights are then in the proportion of the squares of their distances from paper disc.

Make a pin hole camera.

Make strong cardboard tube, blackened inside, about 10 in. long × 2 in. diameter by rolling strip of cardboard round wood cylinder, fastening with glue, and withdrawing wood. Close one end of tube with stout paper, and when dry make pin-hole in centre of end. Make another similar tube to slide within the first, the end, which goes into first tube, being closed with tissue or tracing paper. Directing pin-hole towards window or other brightly illumined object, and looking into other end of tube, an image will be seen on tracing paper. On sliding tube farther in or out, size of image will alter.

Make a reflecting circle.

Cut circle of cardboard 12 in. diameter and graduate it to single degrees. Fix on board and attach two pointed cardboard arms by a screw passing through centre of circle, so that they may move like watch-hands and reach to within $\frac{1}{4}$ in. of edge. Fix small mirror on upper arm exactly over centre of circle and at right angles to direction of arm and plane of circle. On extremity of other arm fix pin, taking care that it is at right angles to plane of circle. Mount on board a short glass tube blackened inside so that axis of the tube is in a line with zero and centre of the circle. The mirror should have a vertical line drawn upon it exactly over centre of circle; the image of pin being made to coincide with this line when instrument is used.

Verify law of reflection with above instrument.

Place both arms pointing to zero; the pin should then exactly cover its own reflection. Move arm carrying pin to 10°; it will be found necessary to move pointer to 5° in order to see image at centre of mirror. If pin moved to 20° pointer will have to be moved to 10°. In this way try various angles of incidence.

N.B.—Observe that in above experiments the angular motion of the reflected ray is always double that of the mirror.

Use instrument as sextant.

The silvering on upper half of mirror being removed so that an object in a line with eye tube and a reflected image may be seen simultaneously, the pointer is to be set at 0°. The mirror being now moved so as to make reflected image of A coincide with B, which is viewed directly; twice the complement of the angle indicated by pointer = the angle between A and B.

Make a glass millimetre scale.

Coat slip of glass 12 in. × 1 in. with thin layer of bees'-wax. Fasten slip down on table with bees'-wax at each end. Similarly fasten down steel millimetre scale at distance of about 3 ft. from slip and so that longest axes of scale and slip are in same straight line. Make fine hole through each end of wood rod 3 ft. long and fix in each hole a large pin, so that point projects about $\frac{1}{4}$ in. Placing one of these pins successively in each division of the steel scale, scratch corresponding divisions through the wax on glass with other pin, making each fifth and tenth division of suitable length. Lay strip of blotting paper wetted with diluted fluoric acid on glass slip and leave for about half an hour. Take up slip, wash off with plenty of water; then remove wax.

Make instrument for measuring vertical heights by reflection.

On board 12 in. × 3 in. × $\frac{1}{4}$ fix slip of wood 10 in. × 1 in. × $\frac{1}{4}$. At one end of slip fix a similar one to stand vertically, the upper end of vertical slip having a thin clean edge, or better, carrying a horizontal metal slit. Make sheet zinc saddle to slide along horizontal slip carrying on it small piece of silvered glass. Rule a line across centre of glass and graduate paper scale on horizontal slip to indicate distances (in millimetres) between line ruled on glass and foot of vertical slip. Make small spirit level and fix on base board.

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Use instrument for measuring heights of ceilings, doors, &c.

Having levelled the base board, look over edge of vertical slip (or through slit) and move mirror until top of wall is seen reflected at centre of mirror. Measure distance from mirror to foot of wall. Call this distance D, the height of wall H, distance on scale of centre of mirror from vertical slip d and height of vertical slip h. Then $d : h = D : H$.

Make circle dividing board.

On a piece of cardboard 14 in. square strike a circle 12 in. diameter with lead pencil. Glue margin outside circle and fix on deal board 14 in. square × ¾ in. On upper side of card describe circle concentric with the other and also of 12 in. diameter. Graduate outer rim into single degrees. Cut out and remove central portion of card. At centre of circle make fine hole and through it from below thrust a stout pin, so that point of pin projects 1 inch above board. Make arm of sheet zinc 8 in. long × 1¼ wide with hole at one end to fit pin and having one side parallel to radius of circle.

Make multiple image apparatus.

Graduate cardboard semicircle 4 in. radius and mount on deal board 8 in. × 4 in. Protect backs of two pieces of silvered glass 4 in. × 2 in., with paper attached by thin glue. Fix stout brass wire pin 5 in. long, vertically at centre of circle. Fix stout paper loops on mirrors so that they hinge upon the pin.

Use apparatus to illustrate law of multiple images.

Incline the mirrors at various angles. Place an object between them and show that $\frac{360°}{N°} - 1 =$ number of images seen; N being the angle between mirrors.

Make concave and convex mirrors.

Clean watch-glasses with nitric acid and tuft of cotton-wool inserted in end of piece of glass tube. Wash first in common water, then with alcohol, and finish with distilled water. Place glass in beaker containing silvering solution, the side to be silvered being upwards. Leave for about three quarters of an hour. Pour off solution and remove glass, being careful not to damage the silvered surface. Remove any silver deposited where not required. Wash in water, allow to become thoroughly dry, then coat silvered surface with thin shellac varnish. Solder together two strips of zinc at right angles, bend ends so as to form a kind of claw in which to hold the mirror. Solder brass wire stem to centre of cross and fix in wood block.

Determine principal focus of concave mirror.

Place mirror, screen, and source of light in same straight line, being careful that the principal axis produced passes through the screen and source of light. Measure distance between source of light and mirror, move screen until a distinct image is produced. Again measure distance between screen and mirror. Insert the numbers so obtained in the following formula :—

$$\frac{1}{u} + \frac{1}{v} = \frac{2}{R} = \frac{1}{f}$$

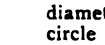
where u and v are the distances between mirror and source of light and mirror and screen, R radius of curvature, and f focal length. Verify result by altering distance between source of light and mirror. Use as screen a piece of tracing stretched on wire ring. The distinctness of the image will be greatly improved by using a cardboard diaphragm to diminish the aperture of the mirror.

movable model to illustrate the law of sines.

Cut three strips of cardboard ½ in. wide × 7 in. long (A, B, & C), two strips 9 in. long (D, E), one 10 in. long (F), and one 17 in. long (G). At ½ in. from each end of each strip make fine hole. On sheet of stout cardboard 21 in. × 13 in. describe a circle 6 in. radius, the centre being 9 in. from one end of board. To centre of circle hinge the two strips A and B, by passing twine through one of the holes in each strip and through board, knotting closely on both sides. To free end of A similarly joint D, and to free end of B joint E. Through centre of the circle draw a diameter produced both ways, parallel to length of card. To free end of D joint both C and G, jointing the free end of C to the board at a distance of 8 in. from the centre on the diameter produced. To the free end of E joint F, and at a point on it 6 in. from E joint it to the board at a point 8 in. from centre of circle on diameter produced. Joint free end of F to free end of G. Cover model with two half-sheets of cartridge paper so as to allow only the slips A and B and portions of D and E representing sines to be seen. Draw circle 8 in. radius on paper with two diameters at right angles. The lower half of the circle may be coloured to indicate denser medium. If preferred the strips may be made of sheet zinc, and joints rivetted with brass wire.

Determine index of refraction of water.

Graduate slip of glass about 8 c.m. by 1 c.m. to m.m. Fix with sealing wax, two equal slips about 4 c.m. long at right angles to scale thus—



Place in water so that uprights are just below surface. Fix an eye tube (blackened inside) at some distance above water and in line of scale, and note division at which top of nearest upright appears on scale. Now carefully withdraw water without disturbing apparatus and again note division. Let height of upright be H, and distances on scale from upright respectively a and A, then $\frac{A}{H}$ = tangent of angle of incidence and $\frac{a}{H}$ = tangent of angle of refraction. From tangents calculate sines, using formula—

$$\text{sine } \theta = \frac{\tan \theta}{\sqrt{1 + \tan^2 \theta}}$$

$$\text{Index of refraction} = \frac{\text{sine of angle of incidence.}}{\text{sine of angle of refraction.}}$$

Verify result by varying angles.

Make bisulphide of carbon lens.

Grind two watch-glasses on sheet of glass with fine emery and turpentine so that their edges come into perfect contact when placed together. Cut notch in edge of each so as to leave small hole for introduction of liquid. Fasten together with glue or isinglass dissolved in acetic acid. When thoroughly set fill with bisulphide, leaving small bubble of air to allow for expansion of liquid. Cover hole with small piece of paper glued on.

Show influence of surrounding medium on properties of a lens.

Blow three glass bulbs, as spherical as possible, on three pieces of tubing. Fill one with water, one with alcohol, and the third with bisulphide of carbon. Partly fill three small glass beakers with same fluids. Place the beakers on piece of printed paper; immerse each bulb successively in each liquid. Looking through the bulb at print, observe whether image be magnified or diminished.

Determine focal length of a convex lens.

(*a*) On one side of the lens place a light, on the other a white screen at such a distance that a clear image of the light is formed upon it. Taking a and b as the

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distances of the light and the image from the lens, and f the required focal length, then—

$$f = \frac{ab}{a+b}$$

(*b*) When the size of the image is the same as that of the object, both the image and the object are at a distance from the lens of double the focal length. The object will be best obtained by cutting two slits in cardboard or scratching them on smoked glass at measured distance from each other; the image may then be focussed on card with distance marked on it.

Make glass cell.

Take three strips of plate glass ¼ in. thick by ½ in. wide; two being 4 in. long and one 3¼ in. Cement temporarily together by a little marine glue. Grind edges flat and at right angles to the surface on sheet of emery paper laid on flat board and moistened with turpentine. Separate and clean strips. Gently warm and smear edges with marine glue. Grind edges of two pieces patent plate glass 4¼ in. by 3¼ in. Clean and warm carefully to such temperature as to melt marine. Lay one piece of plate glass so heated, glue on flat surface; lay strips in position upon it, and lay second plate on top, pressing together to exclude air between glass and glue. When cold clean off superfluous cement and mount cell on wood base.

Make a bisulphide of carbon prism.

Cut off and grind ends of glass tube about 2 in. long by ¾ in. diameter so that planes of ends make an angle of about 60° with each other. Drill hole about ½ in. diameter in middle of tube with hardened point of triangular file and turpentine. Glue pieces of thin sheet glass on ends. Fill with bisulphide of carbon and cover hole with glued paper.

Make a spectroscope.

Make a cardboard tube about 1¼ in. diameter and of focal length of lens provided, at one end of which fix slit drawn on blackened glass or made of thin metal; at other end fix lens. Fix tube and prism on board, prism being mounted on cork and placed in position for minimum deviation for line D. Make cardboard cover blackened inside to exclude extraneous light, and having eye hole in suitable position for viewing spectrum.

Observe spectra of sodium, lithium, strontium, calcium, &c., &c., and learn to recognise presence of these metals in a mixture by their spectra.

Place lighted Bunsen burner opposite slit, and 2 or 3 in. distant from it. Heat platinum wire in flame until it ceases to colour it. Dip wire into solution of salt of the metal, introduce wire into flame, at same time observing spectrum. Having familiarised your eye with spectra separately, try mixtures of the salts.

Test by spectroscope, light transmitted through coloured glasses, liquids, &c.

Placing a luminous flame opposite slit and so obtaining continuous spectrum, interpose the coloured glass between slit and flame; observe what portions of spectrum are cut off. Try effect of looking through two or more of the glasses at luminous flame.

Make a water prism.

Bore clean hole 1¼ in. diameter in block of wood 2 in. square with centrebit. Bevel off sides of block to angle of about 20°. Cut centre hole square. Make small hole for introduction of liquid. Fix two pieces thin plate glass 2 in. square on side with marine glue. When cold fill with water, leaving small bubble to allow for expansion. Fill up hole with marine glue.

Make a polariscope.

Clean and blacken one side of piece of sheet glass 3 in. by 4 in. Fix it on one half of board 3 in. by 8 in. with glue, taking care not to injure black on surface. Fix on other half two uprights at right angles to board, one at the end, the other at 2 in. from end, both being of such height as to support a cardboard-tube making an angle of about 34° with the base board. Make cardboard-tube 1⅞ inches diameter and 6 inches long, and fix on uprights. Make second tube three inches long to fit in upper end. Carefully clean 1¾ inch squares of microscope glass and fix in cork so that surfaces of plates are inclined to axis of tube at an angle of 34°. Fix cork in smaller movable tube. Fix glass plate, as stage, on base board between polariser and end of eye tube, at right angles to axis of latter.

Make selenite figures.

Split selenite into very thin films with thin steel blade. Select pieces of suitable colour by polariscope. Cut so as to form figures of desired shape. Lay together or overlapping on piece sheet glass, fastening down with a little shellac varnish applied at parts which are not to be seen. Sketch outlines and rough details on pieces with ink. Cover with second piece sheet glass blackened so as to expose only the figure. Fasten the two sheets of glass together with paper strips glued along margins.

Make specimens of "Toughened Glass" as objects for polariscope.

Heat strip of ordinary glass in flame until it softens, then plunge into hot oil and move about in oil until cooled to temperature of oil. Remove, wipe clean, and examine.

Make and use cell for exhibiting absorption bands, &c., with spectroscope.

Cut ring about ⅝ inch broad from glass tube about 1¼ inch diameter. Grind edges so as to form wedge. Remove small portion of ring from part equally distant from widest and narrowest part of ring. Cement on plate-glass sides with marine glue. Fill cell successively with solutions of some of the following substances:—Permanganate of potash, roseine, picric acid, ammonio-sulphate of copper, blood. Using luminous flame, place cell in front of slit of spectroscope and observe spectrum, moving cell so as to interpose layer of liquid of varying thickness.

Make simple arrangement for obtaining subjective colours.

Fold piece of white cardboard 12 in. by 6 in. in two, like cover of a book. From the doubled card cut out 16 pieces one inch square, so as to make card like a window-sash, the bars being ⅝ inch wide. Between the folds lay a piece of vividly-coloured tissue paper and hold up to a bright light. After looking steadily for a few seconds the white bars will appear of the colour complementary to that of tissue paper.

To Silver Glass.

Prepare two solutions.

1. Argentic nitrate is dissolved in distilled water, and ammonia added to the solution till the precipitate first thrown down is almost entirely re-dissolved. The solution is filtered and diluted, so that 100 c.c. contain one gramme of argentic nitrate.
2. Two grammes of argentic nitrate are dissolved in a little distilled water and poured into a litre of boiling distilled water. 1·66 gramme of Rochelle salt is added and the mixture boiled for a short time, till the precipitate contained in it becomes grey; it is then filtered hot.

The glass having been *thoroughly cleaned* with (1) nitric acid, (2) water, (3) caustic potash, (4) water, (5) alcohol, and lastly distilled water, is to be placed in a *clean* glass or porcelain vessel, the side to be silvered being placed uppermost. Equal quantities of the two solutions are then to be mixed and poured in so as to cover the glass. This should be done while the glass is still wet with distilled water. In about an hour the silvering will

be completed. Then pour off the exhausted liquid, carefully remove glass, wash in clean water, rub off silver deposited where not required, allow to dry, and varnish silvered side with any thin varnish which does not contract much in drying. The time required for the operation depends on temperature. If the solutions be warmed to about 30° C. the silver is deposited in a few minutes; but it is safer to use them cold. The insides of test-tubes, bulbs, &c., are silvered by putting the solutions into them, no second vessel being then required. *Throughout the whole operation the most scrupulous cleanliness is the grand essential.*

Sound.

Make four paper tubes about 1 inch × 18 inches out of half sheets of cartridge paper; with collars to fit together.

Show that passage of a wave of compression along tube does not produce transfer of matter.
Place small glass flame opposite to end of long tube, allow a little smoke from brown paper to enter tube; clap books together at other end; flame will be extinguished but smoke not ejected.

Try effect of tube in conveying sound.
Join up tubes into long one, place ear at one end, watch at the other; remove tube and ascertain if watch audible at same distance.

Obtain evidence of reflection of sound.
Join your four tubes so as to make two. Place them at a slight angle with each other. Place watch at one end of one tube and ear at adjoining end of other; if watch heard, increase angle between tubes till unheard. Now place card reflector at far end of tubes and adjust till ticking again heard.

Show that sound is reflected by heated air.
Use flat gas flame so that hot air rising from it acts like card in preceding.

Show that as long as continuity of the air is preserved sound passes freely, but is stopped and reflected by thin layer of water.
Place two tubes thus A——B——C, a watch being at A, ear at C, and several folds of a handkerchief or piece of muslin at B. The watch being audible thus, wet one or two folds of the handkerchief and try again.

Try conduction of sound through water.
Beaker of water on sounding box, cork on fork, fastened with sealing wax. Sound fork and touch water with cork.

Try conduction through wood, and iron.
As preceding, with wood or iron rod instead of water.

Make a monochord.
Stout board 3 feet long, 4 inches wide. At 1 inch from one end and 1 inch apart, make holes for, and screw in, two iron screws, leaving heads about $\frac{1}{8}$ inch above board; holes to be so bored that heads of screws are slightly inclined towards end of board. In corresponding positions at other end of board fix small brass pulley and iron rest pin, both at an angle of 45 degs. The pulley is to be near enough to end of board to allow a wire hanging over it to hang freely; the rest pin to fit hole so that it may be turned stiffly with key. Cut two hard wood bridges 1 × 1 × $\frac{3}{4}$ in. for each wire. Twist loop on end of steel wire about 3 feet 6 inches long and slip over head of screw on board, pass other end through rest pin. Place similar wire on other screw and over pulley, making loop at pulley end for hanging weights. Places bridges in position equidistant from ends of board and 30 inches apart. Make paper scale 30 inches long, divided into $\frac{1}{4}$ inches and fix on board between bridges. Make two hard wood movable bridges, higher than the end ones.

Verify the laws of the tranverse vibrations of strings.
(*a.*) Concerning the length of the string.
Measure off $\frac{8}{9}$, $\frac{4}{5}$, $\frac{3}{4}$, $\frac{2}{3}$, $\frac{3}{5}$, $\frac{8}{15}$, $\frac{1}{2}$ of your monochord wire. Letter these intervals D, E, F, &c. Alter the tension of your string till it is in tune with the tuning fork given you. Now place the bridge successively at the intervals above named, vibrate the string and observe the sequence of notes. Inasmuch as the vibration number is inversely as the length of the string—and the above numbers are the inverse ratio of the vibration numbers of the gamut, the notes you obtain ought to be the notes of the gamut. Verify by comparing notes with tuning forks of different pitch.
(*b.*) Concerning the diameter of the string.
Stretch two wires on monochord, one (A) strained by weight, the other by pin; tune to unison. Now substitute thicker wire (B) for the one strained by weight, straining it by same weight. Shorten length of other wire until the two are in unison. The pitch being inversely proportional to diameter,—

$$\frac{\text{Length of B}}{\text{Length of A}} = \frac{\text{Diameter of A}}{\text{Diameter of B.}}$$

Verify by weighing equal lengths of A and B, diameter being proportional to square root of weight.
(*c.*) Concerning the tension of the string.
Tune two wires to unison, one being stretched by smallest weight that will give a clear note. Increase stretching weight to various degrees, ascertaining alteration of pitch by moving bridge of fixed wire until wires in unison. The pitch is proportional to the square root of the stretching weight, *e.g.* if weights as 4 : 9, pitch will be as 2 : 3. Vary by calculating weights required to suit certain alteration of length and verifying.
(*d.*) Concerning the weight of the string.
Tune two steel wires to unison. Substitute brass wire for the one stretched by weight, using same weight. Alter length of fixed wire until wires in unison. The pitch being inversely proportional to the square root of the weight of the string, calculate relative weights of the two wires and verify by weighing.

Solve practically by means of the monochord the following problems:—
a. Weigh pieces of metal of unknown weight.
b. Pitch of one tuning fork being known, ascertain that of another (unknown).
c. Diameter of a German silver wire being known, ascertain its specific gravity.

Demonstrate the existence of harmonics on a vibrating string.
Pluck string at 30, damp lightly with feather or blotting paper at 60, note development of octave. Obtain fifth above by plucking at 60 or 20 and damping at 40 or 80. Similarly test for other overtones.

Examine motion of a tuning fork.
(*a*) Suspend little ball of sealing wax by thread, touch with vibrating fork.
(*b*) Fix flexible style to fork by soft wax. Blacken sheet of glass over gas flame. Vibrate fork and draw style over glass. Fix with very thin varnish.

Make a tonophant:—A simple method of exhibiting Lissajou's figures.
Soften centre of strip of steel 12 inches long, twist round so that plane of upper half of strip is at right angles to lower. Taper off upper strip, fix silvered bead to top with marine glue and clamp lower end of strip in vice. By raising or lowering strip the various rectangular combinations may be obtained.

Obtain Chladni's figures on square and round brass and glass plates. Transfer figures to gummed paper.
Cover a sheet of tea paper evenly with gum. Lay gummed side on sand figure, gently press paper,

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remove and dry carefully. Clean plate after each experiment.

Show existence of nodes and vibrating segments on a bell.

(*a.*) Obtain fundamental note by bowing bell, damping at one-eighth of circumference from bow. Suspend small sealing wax or pitch balls lightly touching outer edge of ball at various places.

(*b.*) Fill bell about two-thirds with water and bow, damping at various points, so as to obtain fundamental note and harmonics. Observe motion of water.

Show response of two tuning forks.

(*a.*) Fix tuning fork upright in wood block, strike second fork in unison with it and hold it near but not touching; observe response of hitherto silent fork. Now load one fork with wax and again try; also try two forks of different pitch; note want of reciprocation. (*b.*) Suspend silvered bead by fine thread so that it hangs touching upper part of one prong of the fixed fork. Repeat experiment as above; movement of bead reveals response of fork. For class purposes a shadow of fork and bead may be thrown on screen.

Show response of air to fork.

(*a.*) Strike tuning fork and hold it over mouth of phial, pouring in water slowly until maximum resonance is obtained from the air within. Now try a fork of different pitch. Note and measure difference in length of air column. (*b.*) Try similar experiment with glass jar tuned by water. (*c.*) Roll up cartridge paper into a tube 1 foot long by 1 inch in diameter, make a second similar cartridge paper tube to slide over the first. Strike fork, hold at end of tube and adjust length of air column till maximum resonance is found. Measure and note this length. (*d.*) Close one end of a tube and repeat experiment, adjusting as before. Inasmuch as a closed organ pipe yields a note an octave lower than an open pipe of the same length, the length of the closed cartridge tube ought to be one-half that of the open tube.

Determine vibration number of a tuning fork by resonance.

Ascertain exact length of closed tube which resounds to fork; this ought to be one-quarter the wave length of fork. Allow for temperature.

Make and use a sensitive flame.

Draw out a piece of $\frac{3}{8}$ths glass tubing; file contracted end to a V shape: (it is easier to do this when the file is under water). Fix glass tube in clip and attach to gas pipe by flexible tubing. Whistle to the gas flame. Try notes of various pitch. Trim your burner if flame is not sensitive enough. Observe the flame in a moving mirror when under the influence of sound. Try in this way the various vowel sounds on the flame. Note the difference of the images of the flame given in the moving mirror.

Making a singing flame apparatus.

Draw out glass tube 9 inches long, bent at right angles 4 inches from end, fix on block of wood; attach to gas pipe by flexible tubing, using a very small flame. Cut two lengths of glass tubing; one to yield a note corresponding to your fork, the other to its octave, Fixing successively in clip, try each over flame. (Owing to the high temperature of air within the tube, the air column will be found longer than anticipated.)

Tune flame and fork to unison.

Make a paper slider 4 or 5 inches long for each tube. Gradually adjust slider till beats are heard very slowly. Now stop singing flame by momentarily placing finger over top of tube, or if necessary raising tube a fraction of an inch. Strike fork, hold near to, or over tube, and thus start flame. Observe vibration of flame in moving mirror.

Start flame by voice.

Obtain flame on brink of sounding as in last experiment; pitch voice to note given by flame and thus start flame at some distance from it, change note and endeavour to silence flame.

Start singing flame by sympathy with another one.

Tune two singing flames by slider until in perfect unison. Stop singing of both. Start one by slight puff or by fork; the other will sing. Repeat experiment, the flames not being in unison; second flame will not be started.

Determine relative velocities of sound in brass, deal, and mahogany rods.

Clamp rod in middle and vibrate longitudinally with resined leather. Tune monochord wire to unison with each rod successively. The lengths of wire used in each case are proportional to velocities in the rods.

Compare velocities in brass and steel wires.

Stretch the wires on monochord, vibrate longitudinally, altering length of one of the wires till in unison. Lengths of the wires are then in same ratio as velocities.

Compare velocities in brass or wood rod with that in air by means of lycopodium dust.

Rod is clamped by a cork which fits tightly into end of a glass tube at least one inch diameter and as long as whole rod. Free end of rod within the tube has fixed on it a cardboard or cork disc which loosely fits tube. Distribute over inside of tube a little lycopodium powder and vibrate rod longitudinally; the dust will be arranged in little heaps at regular intervals, distances being half-wave lengths. Calling one of these distances l, and length of rod L, l : L = velocity in air : velocity in rod.

From above experiments draw up a table of absolute velocities in brass, steel, deal, and mahogany.

Determine pitch of tuning fork or organ pipe by means of the syren.

Vibrate fork with violin bow and work bellows attached to syren. When syren and fork nearly in unison beats will be heard, which become slower the more nearly perfect unison is attained; they then disappear entirely. When this occurs throw wheelwork into gear and keep syren in unison with fork for one minute. Throw wheelwork out of gear and read number of revolutions made by disc. This number multiplied by number of holes in disc and divided by 60 gives number of vibrations per second.

Localisation of Arsenic in the Various Tissues of Poisoned Animals.—M. D. Scolosuboff.—The author's method of research has been to dissolve the organic matter in nitric acid mixed with a little sulphuric, to evaporate almost to dryness, to add then a little sulphuric acid, to heat until fumes of sulphuric acid begin to escape, and to add then, drop by drop, pure nitric acid. This being done, it is heated to incipient carbonisation and exhausted with boiling water; the liquid, whilst hot, is treated for a long time with a current of sulphuretted hydrogen, when sulphide of arsenic is deposited. This is transformed by ordinary methods into arsenic acid, which is then transferred to Marsh's apparatus. The poison seems, both in chronic and acute cases, to accumulate specially in the nervous system. The quantity of arsenic found in 100 grms. of fresh muscle being taken = 1; that in the liver is 10·8; in the brain, 36·5; and in the spinal marrow, 37·3. Possibly arsenic is substituted for phosphorus in the cerebral lecithines.—*Bull. de la Soc. Chim. de Paris,*

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BRITISH ASSOCIATION
FOR THE
ADVANCEMENT OF SCIENCE.

Bristol Meeting.

ADDRESS TO THE MATHEMATICAL AND PHYSICAL SCIENCE SECTION

BY
Professor BALFOUR STEWART, M.A., LL.D.,
President of the Section.

Since the last meeting of the British Association science has had to mourn the loss of one of its pioneers, in the death of the veteran astronomer Schwabe, of Dessau, at a good old age—not before he had faithfully and honourably finished his work. In truth this work was of such a nature that the worker could not be expected long to survive its completion.

It is now nearly fifty years since he first began to produce daily sketches of the spots that appeared upon the sun's surface. Every day on which the sun was visible (and such days are more frequent in Germany than in this country), with hardly any intermission for forty years, this laborious and venerable observer made his sketch of the solar disk. At length this unexampled perseverance met with its reward in the discovery of the periodicity of sun-spots, a phenomenon which very speedily attracted the attention of the scientific world.

It is not easy to overrate the importance of the step gained when a periodicity was found to rule these solar outbreaks.

A priori, we should not have expected such a phenomenon.

If the old astronomers were perplexed by the discovery of sun-spots, their successors must have been equally perplexed when they ascertained their periodicity. For while all are ready to acknowledge periodicity as one of the natural conditions of terrestrial phenomena, yet every one is inclined to ask what there can be to cause it in the behaviour of the sun himself? Manifestly it can only have two possible causes: it must either be the outcome of some strangely hidden periodical cause residing in the sun himself, or must be produced by external bodies, such as planets, acting somehow in their varied positions on the atmosphere of the sun. But whether the cause be an internal or external one, in either case we are completely ignorant of its nature.

We can easily enough imagine a cause operating from the sun himself and his relations with a surrounding medium to produce great disturbances on his surface, but we cannot easily imagine why disturbances so caused should have a periodicity. On the other hand, we can easily enough attach periodicity to any effect caused by the planets, but we cannot well see why bodies comparatively so insignificant should contribute to such very violent outbreaks as we now know sun-spots to be.

If we look within we are at a loss to account for the periodicity of solar disturbances, and if we look without we are equally at a loss to account for their magnitude. But since that within the sun is hidden from our view, it cannot surely be considered blameworthy if astronomers have directed their attention to that without, and have endeavoured to connect the behaviour of sun-spots with the positions of the various planets.

Stimulated, no doubt, by the success which had attended the labours of Schwabe, an English astronomer was the next to enter the field of solar research.

The aim of Mr. Carrington was, however, rather to obtain very accurate records of the positions, the sizes, and the shapes of the various sun-spots, than to make a very extensive and long-continued series of observations. He was aware that a series at once very accurate and very extended is beyond the power of a private individual, and can only be undertaken by an established institution. Nevertheless each sun-spot that made its appearance during the seven years extending from the beginning of 1854 to the end of 1860 was sketched by Mr. Carrington with the greatest possible accuracy, and had also its heliographic positions—that is to say, its solar latitude and longitude—accurately determined.

One of the most prominent results of Mr. Carrington's labours was the discovery of the fact that sun-spots appear to have a proper motion of their own, those nearer the solar equator moving faster than those more remote. Another was the discovery of changes apparently periodical affecting the disposition of spots in solar latitude. It was already known that sun-spots confined themselves to the sun's equatorial regions, but Mr. Carrington showed that the region affected was liable to periodical elongations and contractions, although his observations were not sufficiently extended to determine the exact length of this period.

Before Mr. Carrington had completed his seven years' labours, celestial photography had been introduced by Mr. Warren De la Rue. Commencing with his private observatory, he next persuaded the Kew Committee of the British Association to allow the systematic photography of the sun to be carried on at their observatory under his superintendence, and in the year 1862 the first of a ten years' series of solar photographs was begun. Before this date, however, Mr. De la Rue had ascertained, by means of his photoheliograph, on the occasion of the total eclipse of 1860, that the red prominences surrounding the eclipsed sun belong, without doubt, to our luminary himself.

The Kew observations are not yet finally reduced, but already several important conclusions have been obtained from them by Mr. De la Rue and the other Kew observers. In the first place the Kew photographs confirm the theory of Wilson that sun-spots are phenomena the dark portions of which exist at a level considerably beneath the general surface of the sun; in other words, they are hollows or pits, the interior of which is, of course, filled up with the solar atmosphere. The Kew observers were likewise led to associate the low temperature of the bottom of sun-spots with the downward carriage of colder matter from the atmosphere of the sun, while the upward rush of heated matter was supposed to account for the faculæ or bright patches which almost invariably accompany spots. In the next place, the Kew observers, making use not only of the Kew series, but of those of Schwabe and Carrington, which were generously placed at their disposal, have discovered traces of the influence of the nearer planets upon the behaviour of sun-spots. This influence appears to be of such a nature that spots attain their maximum size when carried by rotation into positions as far as possible remote from the influencing planet—that is to say, into positions where the body of the sun is between them and the planet. There is also evidence of an excess of solar action when two influential planets come near together. But although considerable light has thus been thrown on the periodicity of sun-spots, it ought to be borne in mind that the cause of the remarkable period of eleven years and a quarter, originally discovered by Schwabe, has not yet been properly explained. The Kew observers have likewise discovered traces of a peculiar oscillation of spots between the two hemispheres of the sun, and finally their researches will place at the command of the observers the data for ascertaining whether centres of greater and lesser solar activity are connected with certain heliocentric positions.

While the sun's surface was thus being examined both telescopically and photographically, the spectroscope came to be employed as an instrument of research. It had already been surmised by Prof. Stokes that the vapour of sodium at a comparatively low temperature forms one of the constituents of the solar atmosphere, inasmuch as the dark line D in the spectrum of the sun coincides in

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position with the bright line given out by incandescent sodium vapour.

This method of research was greatly extended by Kirchhoff, who soon found that many of the dark nes n the solar spectrum were coincident with the bright nes of sundry incandescent metallic vapours, and a good beginning was thus made towards ascertaining the chemical constitution of the sun.

The new method soon brought forth further fruit when applied in the hands of Huggins, Miller, Secchi, and others, to the more distant heavenly bodies. It was speedily found that the fixed stars had constitutions very similar to that of the sun. But a peculiar and unexpected success was attained when some of the nebulæ were examined spectroscopically. To-day it seems (so rapidly has knowledge progressed) very much like recalling an old superstition to remind you that, until the advent of the spectroscope, the irresolvable nebulæ were considered to be gigantic and remote clusters of stars, the individual members of which were too distant to be separated from each other, even with a telescope like that of Lord Rosse. But Mr. Huggins, by means of the spectroscope, soon found that this was not the case, and that most of the nebulæ which had defied the telescope gave indications of incandescent hydrogen gas. It was also found by this observer that the proper motions of some of the fixed stars in a direction to or from the earth might be detected by means of the displacement of their spectral lines,—a principle of research which was first enunciated by Fizeau. Hitherto in such applications of the spectroscope the body to be examined was viewed as a whole. It had not yet been attempted to localise the use of this instrument so as to examine particular districts of the sun,—as, for instance, a sun-spot, or the red flames already proved by De la Rue to belong to our luminary. This application was first made by Mr. Lockyer, who, in the year 1865, examined a sun-spot spectroscopically, and remarked the greater thickness of the lines in the spectrum of the darker portion of the spot.

Dr. Frankland had previously found that thick spectral lines correspond to great pressure, and hence the inference from the greater thickness of lines in the umbra of a spot is, that this umbra or dark portion is subject to a greater pressure,—that is to say, it exists below a greater depth of the solar atmosphere than the general surface of the sun. Thus the results derived from the Kew photo-heliograph and those derived from the spectroscope were found to confirm each other. Mr. Lockyer next caused a powerful instrument to be constructed for the purpose of viewing spectroscopically the red flames round the sun's border, in the hope that if they consisted of ignited gas the spectroscope would disperse, and thus dilute and destroy the glare which prevents them from being seen on ordinary occasions.

Before this instrument was quite ready, these flames had been analysed spectroscopically by Capt. Herschel, M. Janssen, and others, on the occasion of a total eclipse occurring in India, and they were found to consist of incandescent gas, most probably hydrogen. But the latter of these observers (M. Janssen) made the important observation that the bright lines in the spectrum of these flames remained visible even after the sun had reappeared, from which he argued that a solar eclipse is not necessary for the examination of this region.

Before information of the discovery made by M. Janssen had reached this country, the instrument of Mr. Lockyer had been completed, and he also found that by its means he was able to analyse at leisure the composition of the red flames without the necessity of a total eclipse. An atmosphere of incandescent hydrogen was found to surround our luminary, into which, during the greater solar storms, sundry metallic vapours were injected—sodium, magnesium, and iron forming the three that most frequently made their appearance.

Here we come to an interesting chemical question.

It had been remarked by Maxwell and by Pierce, as the result of the molecular theory of gases, that the final distribution of any number of kinds of gas in a vertical direction under gravity is such that the density of each gas at a given height is the same as if all the other gases had been removed, leaving it alone.

In our own atmosphere the continual disturbances prevent this arrangement from taking place; but in the sun's enormously extended atmosphere (if, indeed, our luminary be not nearly all gaseous) it appears to hold, inasmuch as the upper portion of this atmosphere, dealing with known elements, apparently consists entirely of hydrogen.

Various other vapours are, however, as we have seen, injected from below the photosphere into the solar atmosphere on the occasion of great disturbances; and Mr. Lockyer has asked the question, whether we have not here a true indication of the relative densities of these various vapours derived from the relative heights to which they are injected on such occasions?

This question has been asked, but it has not yet received a definite solution; for chemists tell us that the vapour densities of some of the gases injected into the sun's atmosphere on the occasion of disturbances are—as far as they know from terrestrial observations—different from those which would be indicated by taking the relative heights attained in the atmosphere of the sun. Mr. Lockyer has attempted to bring the question a step nearer to its solution by showing that the vapours at the temperature at which their vapour densities have been experimentally determined are not of similar molecular constitution, whereas in the sun we get an indication from the fact that all the elements give us line spectra, that they are in similar molecular states.

Without, however, attempting to settle this question, I may remark that we have here an interesting example of how two branches of science, physics and chemistry, meet together in solar research.

It had already been observed by Kirchhoff that sometimes one or more of the spectral lines of an elementary vapour appear to be reversed in the solar spectrum, while the other lines did not experience reversal. Mr. Lockyer succeeded in obtaining an explanation of this phenomenon. This explanation was found by means of the method of localisation already mentioned.

Hitherto, when taking the spectrum of the electric spark between the two metallic poles of a coil, the arrangements were such as to give an average spectrum of the metal of these poles; but it was found that when the method of localisation was employed, different portions of the spark gave a different number of lines, the regions near the terminals being rich in lines, while the midway regions give comparatively few.

If we imagine that in the midway regions the metallic vapour given off by the spark is in a rarer state than that near the poles, we are thus led to regard the short lines which cling to the poles as those which require a greater density or nearness of the vapour particles before they make their appearance, while, on the other hand, those which extend all the way between the two poles come to be regarded as those which will continue to make their appearance in vapour of great tenuity.

Now it was remarked that these long lines were the very lines which were reversed in the atmosphere of the sun. Hence when we observe a single coincidence between a dark solar line and the bright line of any metal, we are further led to inquire whether this bright line is one of the long lines which will continue to exist all the way between two terminals of that metal when the spark passes.

If this be the case, then we may argue with much probability that the metal in question really occurs in the solar atmosphere; but if, on the other hand, the coincidence is merely between a solar dark line and a short bright one, then we are led to imagine that it is not a true coincidence, but something which will probably disappear on further examination. This method has already afforded us a means of determining the relative amount of the

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various metallic vapours in the sun's atmosphere. Thus in some instances all lines are reversed, whereas in others the reversal extends only to a few of the longer lines.

Several new metals have thus been added to the list of those previously detected in the solar atmosphere; and it is now certain that the vapours of hydrogen, potassium, sodium, rubidium, barium, strontium, calcium, magnesium, aluminium, iron, manganese, chromium, cobalt, nickel, titanium, lead, copper, cadmium, zinc, uranium, cerium, vanadium, and palladium occur in our luminary.

I have spoken hitherto only of telescopic spectroscopy; but photography has been found capable of performing the same good service towards the compound instrument consisting of the telescope and its attached spectroscope which it had previously been known to perform towards the telescope alone.

It is of no less importance to secure a permanent record of spectral peculiarities than it is to secure a permanent record of telescopic appearances.

This application of photography to spectrum observations was first commenced on a sufficient scale by Mr. Rutherford, of New York, and already promises to be one of the most valuable aids in solar inquiry.

In connection with the spectroscope I ought here to mention the names of Respighi and Secchi, who have done much in the examination of the solar surface from day to day. It is of great importance to the advancement of our knowledge that two such competent observers are stationed in a country where the climate is so favourable to continued observation.

The examination of the sun's surface by the spectroscope suggests many interesting questions connected with other branches of science. One of these has already been alluded to.

I may mention two others put by Mr. Lockyer, premising, however, that at present we are hardly in a position to reply to them.

It has been asked whether the very high temperatures of the sun and of some of the stars may not be sufficient to produce the disassociation of those molecular structures which cannot be disassociated by any terrestrial means; in other words, the question has been raised whether our so-called elements are really elementary bodies.

A third question is of geological interest. It has been asked whether a study of the solar atmosphere may not throw some light upon the peculiar constitution of the upper strata of the earth's surface, which are known to be of less density than the average interior of our planet.

If we have learned to be independent of total eclipses, as far as the lower portions of the solar atmosphere are concerned, it must be confessed that as yet the upper portions—the outworks of the sun—can only be successfully approached on these rare and precious occasions. Thanks to the various Government expeditions despatched by Great Britain, by the United States, and by several Continental nations,—thanks, also, to the exertions of Lord Lindsay and other astronomers,—we are in the possession of definite information regarding the solar corona.

In the first place, we are now absolutely certain that a large part of this appendage unmistakably belongs to our luminary, and in the next place we know that it consists—in part at least—of an ignited gas giving a peculiar spectrum, which we have not yet been able to identify with that of any known element.

The temptation is great to associate this spectrum with the presence of something lighter than hydrogen, of the nature of which we are yet totally ignorant.

A peculiar physical structure of the corona has likewise been suspected. On the whole, we may say that this is the least known—while it is perhaps the most interesting—region of solar research; most assuredly it is well worthy of further investigation.

If we now turn our attention to matters nearer home, we find that there is a difficulty in grasping the facts of terrestrial meteorology no less formidable than that which assails us when we investigate solar outbreaks. The latter perplex us because the sun is so far away, and because also his conditions are so different from those with which we are here familiar; while, on the other hand, the former perplex us because we are so intimately mixed up with them in our daily lives and actions—because, in fact, the scale is so large and we are so near. The result has been that until quite recently our meteorological operations have been conducted by a band of isolated volunteers, individually capable and skilful, but, from their very isolation, incapable of combining together with advantage to prosecute a scientific campaign. Of late, however, we have begun to perceive that if we are to make any advance in this very interesting and practical subject, a different method must be pursued, and we have already reaped the first fruits of a more enlightened policy; already we have gained some knowledge of the constitution and habits of our atmosphere.

The researches of Wells and Tyndall have thrown much light on the cause of dew. Humboldt, Dove, Buys Ballot, Jelinek, Quetelet, Hansteen, Kupffer, Forbes, Welsh, Glaisher, and others, have done much to give us an accurate knowledge of the distribution of terrestrial temperature.

Great attention has likewise been given to the rainfall of Great Britain and Ireland, chiefly through the exertions of one individual, Mr. G. J. Symons.

To Dove we are indebted for the law of rotation of the wind; to Redfield, for the spiral theory of cyclones; to Francis Galton, for the theory of anti-cyclones; to Buchan, for an investigation into the disposition of atmospheric pressure which precedes peculiar types of weather; to Stevenson, for the conception of barometric gradients; to Scott and Meldrum, for an acquaintance with the disposition of winds which frequently precedes violent outbreaks; and to come to the practical application of laws, we are much indebted to the late Admiral FitzRoy, and the system which he greatly helped to establish, for our telegraphic warnings of coming storms.

Again, the meteorology of the ocean has not been forgotten. The well-known name of Maury will occur to every one as that of a pioneer in this branch of inquiry. FitzRoy, Leverrier, Meldrum, Toynbee, and others, have likewise done much; and it is understood that the meteorological offices of this and other maritime countries are now busily engaged upon this important and practical subject. Finally, the movements of the ocean and the temperatures of the oceanic depths have recently been examined with very great success in vessels despatched by Her Majesty's Government; and Dr. Carpenter has by this means been able to throw great light upon the convection-currents exhibited by that vast body of water which girdles our globe,

It would be out of place to enter here more minutely into this large subject, and already it may be asked what connection has all this with that part of the address that went before it.

There are, however, strong grounds for supposing that the meteorology of the sun and that of the earth are intimately connected together. Mr. Broun has shown the existence of a meteorological period connected apparently with the sun's rotation, five successive years' observations of the barometer at Singapore all giving the period 25·74 days. Mr. Baxendell, of Manchester, was, I believe, the first to show that the convection-currents of the earth appear to be connected somehow with the state of the sun's surface as regards spots; and still more recently Mr. Meldrum, of the Mauritius Observatory, has shown, by a laborious compilation of ships' logs, and by utilising the meteorological records of the island, that the cyclones in the Indian Ocean are most frequent in years when there are most sun-spots. He likewise affords us grounds for supposing that the rainfall, at least in the tropics, is greatest in years of maximum solar disturbance.

M. Poey has found a similar connection in the case of the West Indian hurricanes; and finally, Piazzi Smyth, Stone, Köppen, and, still more recently, Blanford, have

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been able to bring to light a cycle of terrestrial temperature having apparent reference to the condition of the sun.

Thus we have strong matter-of-fact grounds for presuming a connection between the meteorology of our luminary and that of our planet, even although we are in complete ignorance as to the exact nature of this bond.

If we now turn to terrestrial magnetism the same connection becomes apparent.

Sir Edward Sabine was the first to show that the disturbances of the magnetism of the earth are most violent during years of maximum sun spots. Mr. Broun has shown that there is likewise a reference in magnetic phenomena to the period of the sun's rotation about his axis, an observation recently confirmed by Hornstein; and still more recently Mr. Broun has shown that the moon has an action upon the earth's magnetism, which is not altogether of a tidal nature, but depends, in part at least, upon the relative position of the sun and moon.

I must trust to your forbearance if I now venture to bring forward considerations of a somewhat speculative nature.

We are all familiar with the generalisation of Hadley; that is to say, we know there are under currents sweeping along the surface of the earth from the poles to the equator, and upper currents sweeping back from the equator to the poles. We are likewise aware that these currents are caused by the unequal temperature of the earth; they are in truth convection currents, and their course is determined by the positions of the hottest and coldest parts of the earth's surface. We may expect them, therefore, to have a reference not so much to the geographical equator and poles as to the hottest and coldest regions. In fact we know that the equatorial regions into which the trade winds rush and from which the anti-trades take their origin, have a certain annual oscillation depending upon the position of the sun, or, in other words, upon the season of the year. We may likewise imagine that the region into which the upper currents pour themselves is not the geographical pole, but the pole of greatest cold.

In the next place we may imagine that these currents, as far as regards a particular place, have a daily oscillation. This has, I believe, been proved as regards the lower currents or trade winds, which are more powerful during the day than during the night, and we may therefore expect it to hold good with regard to the upper currents or anti-trades; in fact we cannot go wrong in supposing that they also, as regards any particular place, exhibit a daily variation in the intensity with which they blow.

Again, we are aware that the earth is a magnet. Let us not now concern ourselves about the origin of its magnetism, but rather let us take it as it is. We must next bear in mind that rarefied air is a good conductor of electricity; indeed, according to recent experiments, an extremely good conductor. The return trades that pass above from the hotter equatorial regions to the poles of cold, consisting of moist rarefied air, are therefore to be regarded in the light of good conductors crossing lines of magnetic force; we may therefore expect them to be the vehicle of electric currents. Such electric currents will of course react on the magnetism of the earth. Now, since the velocity of these upper currents has a daily variation, their influence as exhibited at any place upon the magnetism of the earth may be expected to have a daily variation also.

The question thus arises, Have we possibly here a cause which may account for the well-known daily magnetic variation? Are the peculiarities of this variation such as to correspond to those which might be expected to belong to such electric currents? I think it may be said that, as far as we can judge, there is a likeness of this kind between the peculiarities of these two things; but a more prolonged scrutiny will of course be essential before we can be absolutely certain that such currents are fitted to produce the daily variation of the earth's magnetism.

Besides the daily and yearly periodic changes in these upper convection currents, we should also expect occasional and abrupt changes forming the counterparts of those disturbances in the lower strata with which we are familiar. And these may be expected in like manner to produce non-periodic occasional disturbances of the magnetism of the earth. Now it is well known that such disturbances do occur, and further that they are most frequent in those years when cyclones are most frequent, that is to say, in years of maximum sun-spots. In one word, it appears to be a tenable hypothesis to attribute at least the most prominent magnetic changes to atmospheric motions taking place in the upper regions of the atmosphere where each moving stratum of air becomes a conductor moving across lines of magnetic force; and it was Sir William Thomson, I believe, who first suggested that the motion of conductors across the lines of the earth's magnetic force must be taken into account in any attempted explanation of terrestrial magnetism.

It thus seems possible that the excessive magnetic disturbances which take place in years of maximum sun spots may not be directly caused by any solar action, but may rather be due to the excessive meteorological disturbances which are likewise characteristic of such years; on the other hand, that magnetic and meteorological influence which Mr. Broun has found to be connected with the sun's rotation points to some unknown direct effect produced by our luminary, even if we imagine that the magnetic part of it is caused by the meteorological. Mr. Broun is of opinion that this effect of the sun does not depend upon the amount of spots on his surface.

In the next place, that influence of the sun in virtue of which we have most cyclones and greater meteorological disturbance in the years of maximum spots, cannot, I think (as far as we know at present) be attributed to a change in the heating power of the sun. We have no doubt traces of a temperature effect which appears to depend upon the sun period; but its amount is very small, whereas the variation in cyclonic disturbance is very great. We are thus tempted to associate this cyclone-producing influence of the sun with something different from his light and heat. As far, therefore, as we can judge, our luminary would appear to produce three distinct effects upon our globe. In the first place, a magnetic and meteorological effect, depending somehow upon his rotation; secondly, a cyclonic effect, depending somehow upon the disturbed state of his surface; and lastly, the well-known light and heat effect with which we are all familiar.

If we now turn to the sun, we find that there are three distinct forms of motion which animate his surface particles. In the first place, each particle is carried round by the rotation of our luminary; secondly, each particle is influenced by the gigantic meteorological disturbances of the surface, in virtue of which it may acquire a velocity ranging as high as 130 or 140 miles a second; and lastly, each particle, on account of its high temperature, is vibrating with extreme rapidity, and the energy of these vibrations communicated to us by means of the etherial medium produces the well-known light and heat effect of the sun.

Now, is it philosophical to suppose that it is only the last of these three motions that influences our earth, while the other two produce absolutely no effect? On the contrary, we are, I think, compelled by considerations connected with the theory of energy, to attribute an influence, whether great or small, to the first two as well as to the last.

We are thus led to suppose that the sun must influence the earth in three ways, one depending on his rotation, another on his meteorological disturbance, and a third by means of the vibrations of his surface particles.

But we have already seen that, as a matter of fact, the

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sun does appear to influence the earth in three distinct ways—one magnetically and meteorologically, depending apparently on his period of rotation; a second cyclonically, depending apparently on the meteorological conditions of his surface; and a third by means of his light and heat.

Is this merely a coincidence, or has it a meaning of its own? We cannot tell; but I may venture to think that in the pursuit of this problem we ought to be prepared at least to admit the possibility of a threefold influence of the sun.

Even from this very meagre sketch of one of the most interesting and important of physical problems, it cannot fail to appear that while a good deal has already been done, its progress in the future will very greatly depend on the completeness of the method and continuity of the observations by which it is pursued. We have here a field which is of importance not merely to one, or even to two, but almost to every conceivable branch of research.

Why should we not erect in it a sort of science-exchange into which the physicist, the chemist, and the geologist may each carry the fruits of his research, receiving back in return some suggestion, some principle, or some other scientific commodity that will aid him in his own field.

But to establish such a mart must be a national undertaking, and already several nations have acknowledged their obligations in this respect.

Already the German Government have established a Sonnenwarte, the mere building and equipment of which is to cost a large sum. With an appreciation of what the spectroscope has done for this inquiry, the first directorship was offered to Kirchhoff, and on his declining it, Herr Vogel has been placed in charge. In France also a physical observatory is to be erected at Fontenay, on an equal, if not greater scale, of which Janssen has already accepted the directorship; while in Italy there are at least three observatories exclusively devoted to this branch of research.

Nor must we forget that in this country the new observatory at Oxford has been so arranged that it can be employed in such inquiries. But what has England as a nation done?

Some years since, at the Norwich Meeting of this Association, a movement was set on foot by Colonel Strange which resulted in the appointment of a Royal Commission on the advancement of science, with the Duke of Devonshire as chairman. This Commission have quite recently reported on the steps that ought in their opinion to be taken for the advancement of scientific research.

One of their recommendations is expressed in the following words:—

"Important classes of phenomena relating to physical meteorology and to terrestrial and astronomical physics require observations of such a character that they cannot be advantageously carried on otherwise than under the direction of Government. Institutions for the study of such phenomena should be maintained by the Government; and in particular an observatory should be founded specially devoted to astronomical physics."

If the men of science of this country who procured the appointment of this commission, and who subsequently gave evidence before it, will now come forward to support its recommendations, it can hardly be doubted that these will be speedily carried into effect.

But other things besides observations are necessary if we are to pursue with advantage this great physical problem.

One of these is the removal of the intolerable burden that has hitherto been laid upon private meteorologists and magneticians. Expected to furnish their tale of bricks, they have been left to find their own straw. Nothing more wretched can be imagined than the position of an amateur (that is to say, a man who pursues science for the love of it, and is unconnected with any establishment) who has set himself to promote observational inquiries, whether in meteorology or magnetism.

He has first to obtain with great expenditure of time or money, or both, copies of the individual observations taken at some recognised institution. He has next to reduce these in the way that suits his inquiry, an operation again consuming time and demanding means. Let us suppose all this to be successfully accomplished, and a valuable result obtained. It is doubtless embodied in the Transactions of some Society, but it excites little enthusiasm; for it consists of something which cannot be repeated by every one for himself like a new and interesting experiment. Yet the position of such men has recently been improved. Several observatories and other institutions now publish their individual observations; this is done by our Meteorological Office, while Dr. Bergsma, Dr. Neumayer, and Mr. Broun are recent examples of magneticians who have adopted this plan. The publication of the work of the latter is due to the enlightened patronage of the Rajah of Travancore, who has thus placed himself in front of the princes of India and given them an example which it is to be hoped they will follow. But this is only one step in the right direction; another must consist in subsidising private meteorologists and magneticians in order to enable them to obtain the aid of computers in reducing the observations with which they have been furnished. The man of science would thus be able to devote his knowledge, derived from long study, to the methods by which results, and the laws regulating them, are to be obtained; he could be the architect and builder of a scientific structure without being forced to waste his energies on the work of a hodman.

Another hindrance consists in our deficient knowledge as to what observations of value in magnetism and meteorology have already been made. We ought to have an exhaustive catalogue of all that has been done in this respect in our globe, and of the conditions under which the various observations will be accessible to outside inquirers. A catalogue of this kind has been framed by a committee of this Association, but it is confined to the dominions of England, and requires to be supplemented by a list of that which has been done abroad.

A third drawback is the insufficient nature of the present facilities for the invention and improvement of instruments, and for their verification.

We have no doubt advanced greatly in the construction of instruments, especially in those which are self-recording. The names of Brooke, Robinson, Welsh, Osler, and Beckley, will occur to us all as improvers of our instruments of observation. Sir W. Thomson has likewise adapted his electrometer to the wants of meteorology. Dr. Roscoe has given us a self-recording actinometer; but a good instrument for observing the sun's heat is still a desideratum. It ought likewise to be borne in mind that the standard mercurial thermometer is by no means a perfect instrument.

In conclusion, it cannot be doubted that a great generalisation is looming in the distance—a mighty law, we cannot yet tell what, that will reach us, we cannot yet say when. It will involve facts hitherto inexplicable, facts that are scarcely received as such because they appear opposed to our present knowledge of their causes. It is not possible, perhaps, to hasten the arrival of this generalisation beyond a certain point; but we ought not to forget that we *can* hasten it, and that it is our duty to do so. It depends much on ourselves, our resolution, our earnestness, on the scientific policy we adopt, as well as on the power we may have to devote ourselves to special investigations, whether such an advent shall be realised in our day and generation, or whether it shall be indefinitely postponed. If Governments would understand the ultimate *material* advantages of every step forward in science, however inapplicable each may appear for the moment to the wants or pleasures of ordinary life, they would find reasons, patent to the meanest capacitie

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for bringing the wealth of mind, now lost on the drudgery of common labours, to bear on the search for those wondrous laws which govern every movement, not only of the mighty masses of our system, but of every atom distributed throughout space.

NOTE ON THE DETERMINATION OF MAGNESIA IN DRINKING WATER.

By J. ALFRED WANKLYN.

Since the presence of more than a minute proportion of magnesia in water renders water medicinal and unfits it for general domestic use, a rapid method of determining magnesia in drinking water is a desideratum. For this purpose the soap test may be resorted to, and I find that by a very simple and obvious procedure the magnesia may be determined with great rapidity and with sufficient accuracy for the purpose.

My method of procedure is as follows:—

Into a stoppered bottle of the capacity of about a litre, I pour 700 cubic centimetres of the water to be analysed and add 0·5 gramme of finely powdered oxalate of ammonia. The bottle is then shaken for some half-minute, and presently its contents are poured on a filter. The first portions of the filtrate may be rejected, and 70 cubic centimetres of filtrate may then be submitted to the soap test, and the hardness noted down. If the water to be tested be sufficiently free from magnesia, the filtrate after precipitation with oxalate of ammonia should not require more than three soap measures in order to give a very full and durable lather. Waters charged with magnesia, on the other hand, require much more soap test to produce a full and permanent lather. Those chemists who have had much experience with the soap test are familiar with the fact that the hardness due to magnesia is very different in many respects from the hardness due to lime.

It may be useful to point out some of the differences between the behaviour of magnesia and lime towards soap test. In the first place the magnesia hardness, in dilute solutions, is not *equivalent* to the lime hardness. If, for example, a water containing nothing but carbonate of lime be of 13 degrees of hardness it would not be of 13 degrees of hardness if the lime were replaced by its equivalent of magnesia; but it would be of about 19 degrees of hardness. I find namely, on experiment, that whereas one equivalent of lime decomposes one equivalent of soap, one equivalent of magnesia decomposes one and a half equivalents of soap. In concentrated solutions magnesia behaves quite differently towards soap test. Another point to be noted is that a certain lapse of time is required for the production of the magnesia hardness, whilst lime hardness is immediate.

ON CHROME-IRON ALLOY.

By SERGIUS KERN, St. Petersburg.

In Russia in the Oural Mountains a great amount of chrome-ironstone ($Cr_2O_3.FeO$) was found during the last ten or fifteen years, so that this ore is very cheap in Russia. In order to find out if it could replace spiegeleisen for the manufacture of steel by Siemens's process, some experiments were made, the results of which are as follows:—

A mixture consisting of

	Parts.
Chrome-ironstone	315
Charcoal powder	200
Lime	70

was intimately mixed and ignited in a graphite crucible on a coke furnace with a powerful blast for about one hour. On opening the crucible a metallic ingot was found having a silverish fracture. The analysis of it gave the following average composition of the alloy:—

	Per cent.
Chrome	74
Iron	25
Foreign matter	1
	100

The chrome-iron alloy, or as it may be called *chromeisen*, possesses the properties of diamond in regard to its hardness. It cuts glass very easily, and could be used for this purpose instead of expensive diamonds. But this alloy may be used not only for this purpose; it can be a very good and cheap substitute for the spiegeleisen used in Siemens's steel process. Further experiments commenced in one of the Russian steel works will show the fitness of chromeisen in steel manufacture.

CORRESPONDENCE.

ENGLISH WORK.

To the Editor of the Chemical News.

Sir,—I have just read in your columns the interesting address of Mr. Vernon Harcourt to the Chemical Section of the British Association. I regret, however, to find that once more we are treated in this address to the same unjust remarks on English Work in Chemistry which have, on former occasions, been so liberally showered upon us by other eminent and short-sighted professors. These gentlemen judge of the work done in England by the publication known as the *Journal of the Chemical Society of London*. Now, sir, I venture to assert that that periodical does not, and never did, represent one quarter of the work done in England by English chemists.

As regards the importance of English discoveries in science, compared to those made by our continental brethren, let the world judge. Let us only cast our eyes over the voluminous original writings of Frankland, Faraday, Herapath, Graham, Calvert, Stenhouse, Field, Phipson, Wright, Perkin, Gladstone, Crookes, Greville Williams, Maxwell Simpson, &c., to be convinced that our scientific men are second to none in the world. But as regards chemistry there are a greater number of chemical students abroad, because education there is cheaper than with us, and in this country men are trained in greater numbers for the law and the church than for science. Hence, we have had a larger number of distinguished statesmen than of philosophers. After all this may be an advantage. As a rule scientific men do not make good statesmen, whilst a statesman or a lawyer may become an eminent man of science. But to return to chemistry it is very hard that we should be constantly reminded of the small number of scientific chemists working in England, and if it is only done for the sake of drawing more pupils into some particular school or college where chemistry is taught, or as an endeavour to foster chemical study by infusing into it a kind of vapid patriotism, it is a rather paltry way of doing so. Allow us while such remarks are still ringing in our irritated ears to remind our English chemists that whilst going on in their own quiet way they have given to the world the atomic theory, cast steel, and the coal tar colours, besides a few other little details ranging from oxygen to thallium. Indeed, M. Würtz would have been nearer the truth, and more polite, had he modified his little sentence and asserted "La Chimie est une Science *Anglaise*."—I am, &c.,

EQUIVALENT.

Dr. Attfield's Work on Chemistry.—A sixth (illustrated) edition of Prof. Attfield's "Chemistry" will, we understand, be published on October 1.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 825.

THE ROYAL COMMISSION ON SCIENTIFIC INSTRUCTION.*

I.

WHILST our rivals are acting it is a great consolation to know that we are at least talking, and that possibly some day something may be done, unless, as occasionally happens, the subject should be "dropped." At present, far from being agreed as to what should best be done to extend and improve scientific instruction and to advance science, we are not all convinced that anything is needful or that our position is in any way unsatisfactory.

We wish we could accept this last view. No one can deny that the share taken by Britain in the great task of discovery during the past century has been not merely creditable, but splendid. But this —with all due respect to our able correspondent "Equivalent"—is not exactly the question. The real points at issue are these: Are we doing relatively as much scientific work now as in former days? Are we producing in proportion to our population and our opportunities as many discoveries as, say, the Germans? Let us ask how many aliens are now holding professorships or assistantships in chemistry, physics, &c., in our universities, colleges, and higher schools, curatorships in our museums and botanical gardens, or scientific appointments in our manufactories, and, on the other hand, how many British subjects hold analogous positions on the Continent? We fear the latter number would prove almost inappreciable in comparison with the former. "There are a greater number of chemical students abroad because education there is cheaper than with us, and in this country men are trained in greater numbers for the law and the church than for science." Precisely so; and these are some of the very evils of which we complain. Is it necessary, or desirable that the cost of a scientific education should be about five times greater here than in Germany,—a ratio quite out of keeping with the respective cost of living in the two countries? And why are men here trained for the law or the church rather than for science save because the facilities for the latter career are so scanty and its tangible rewards scantier still? Our friend "Equivalent" thinks this excess of lawyers and divines may be an advantage. He holds that "as a rule scientific men do not make good statesmen, whilst a statesman or a lawyer may become an eminent man of science." But we want scientific men to devote themselves to their own department, not to make statesmen, of *any* sort. It might, however, be desirable that statesmen should more frequently take the advice of men of science, and that when they require such advice they should not expect it to be furnished gratuitously. A statesman or a lawyer may, possibly, become an eminent man of science. So, we must add, may a bookbinder or a stone-mason. But in all such rare cases we can only regret that the individual concerned, instead of wasting his time, was not from the first specially and exclusively trained for scientific pursuits.

But if we assume it, for the present, that our national position as regards facilities for scientific instruction are not what the necessities of the age demand, our difficulties are only beginning. State aid may shelter and cherish, but it may also cramp and enfeeble. Nay, the possibility is that it may enfeeble without sheltering. We must not, under pretence of fostering chemistry, place chemists under the sway of a "Department," or fetter them, soul and body, in red tape. It might be very well to provide a number of *emeritus* professorships, college fellowships, or the like, where men of proved competence might devote themselves to scientific research, undisturbed by the cares and anxieties of a competitive life. But we know that the noisy, impudent sparrow often contrives to seize the nest of the modest swallow. In like manner we fear that the posts destined for men of science would in most cases be usurped by obtrusive men of the world, or by "pushing" charlatans. At best they would be awarded, not to the most meritorious, but to the partisans of some dominant clique. To afford facilities for the thorough study of chemistry at a reasonable fee would be most beneficial. But if the movement is undertaken, as "Equivalent" puts it, "for the sake of drawing more pupils into some particular school or college where chemistry is taught," or for installing some particular school and its heads as supreme over all others, it is not merely "paltry," but reprehensible. We must beware lest whilst seeking to promote science we merely subserve the personal aggrandisement of Doctor A or Professor B. When the English Government strives to be "paternal" it is exceeding liable to commit some awkward mistake. Any other government, for instance, in seeking a site in its capital for museums and schools of art and science, would have made centrality the first consideration. *Our* authorities, on the contrary, banish their "*Quartier Latin*" to the remote though fashionable suburb of South Kensington,—a step, to borrow the language of a contemporary, about as rational as to "erect the new Courts of Law upon Bow Common, or to transfer the Bank of England to Hampstead Heath, and the Royal Exchange to Peckham Rye!"

Seing that the little hitherto done by the state for science includes so gigantic a blunder, we cannot entertain any very sanguine hopes as to the future.

* "Sixth, Seventh, and Eight Reports of the Royal Commission on Scientific Instruction and the Advancement of Science." London: Printed for Her Majesty's Stationery Office, 1875.

ON THE PREPARATION OF STRONTIUM SULPHIDE.

By SERGIUS KERN, St. Petersburg.

BY the following method, strontium sulphide (SrS) is easily received:—Concentrated solutions of strontium chloride ($SrCl_2$) and sodium hyposulphite—

$$(Na_2S_2O_3+5H_2O)$$

are mixed together; the solution contains, then, sodium chloride (NaCl) and strontium hyposulphite (SrS_2O_3), both soluble salts, so that no precipitate is received:—

$$SrCl_2+Na_2S_2O_3=SrS_2O_3+2NaCl.$$

The strontium hyposulphite may be precipitated by ordinary alcohol, or, as it was found better, by methyl alcohol (C_2H_4O); the precipitate is washed, dried, and strongly heated. The strontium hyposulphite is then decomposed by the heat, and the remainder is a mixture

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of strontium sulphide (SrS), strontium sulphate ($SrSO_4$), and of a small quantity of free sulphur. The following equation represents the decomposition of the salt:—

$$2SrS_2O_3 = SrS + SrSO_4 + S + SO_2.$$

This mixture is usually employed for demonstrating the phosphorescence of metallic sulphides of alkaline earths, but, for the purpose of obtaining pure strontium sulphide, the following process was found to be the best:—The mass resulting from the heating of strontium hyposulphite is converted into powder and dissolved in water; the strontium sulphide (SrS) remains in solution, and a precipitate is left containing strontium sulphate and free sulphur; the solution is filtered and evaporated on a sand-bath, and the pure strontium sulphide is dried over sulphuric acid.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

(Continued from p. 103.)

How great would be the influence of a cheap source of ozone upon manufactures appears at once from the fact that in the nascent state this body oxidises nitrogen to nitric acid. The presence of the latter body in thunder-rain has long ago been found to result from this circumstance. The manufacture of ozone would, therefore, involve nothing less than the synthesis of this important mineral acid, hitherto only procured from nitre.

That in grass-bleaching and in disinfection by means of ethereal oils we have from time immemorial made use of ozone—generated in the one case by the growth of grass, and in the other by the hydrocarbons—can only serve to intensify our longing for the technical production of ozone. Upon such a process depends the method of bleaching ivory, as it has been conducted since 1850 in Meyer's walking-stick manufactory at Hamburg, and subsequently at other places. The ivory is immersed for weeks in photogen, or other volatile oils, exposed to strong sunshine and to air, whereby the latter is ozonised and bleaches.

The first patent for the application of ozone was recently granted in England. In order to form acetic acid from alcohol without fermentation, the inventors† obtain ozone by blowing air through a flame and bringing it in contact with a current of alcohol. A practical verification of the procedure has not been furnished.

Hydrogen.

Of the three properties to which the industrial applications of hydrogen are applicable two are of so striking a nature that they cannot have escaped the earliest observers. To them it appeared as the combustible principle, the "volatile sulphur;"‡ subsequently, it was regarded as the long-sought-for phlogiston,‖ or as the "inflammable air," of which all combustible gases were mere varieties. In modern times, this previously vague knowledge has been rendered definite, recognising in hydrogen the greatest heat of combustion, and consequently the property of producing the highest degrees of heat and light, properties which met with a practical application at an early date.

The low specific gravity of hydrogen did not escape the earliest observers. Being scarcely ponderable, it excited the idea of imponderable bodies, and its specific lightness, as well as its great heat of combustion, soon met with a striking application.

A third attribute is of a less manifest nature. Occasionally destroying colours, but often obtained without any brilliant and striking phenomena, hydrogen in its nascent state is capable of entering into many combinations, of which it is incapable when pre-existing in a free state. It liberates chlorine, oxygen, and other elements from their compounds, and takes their place; or it is deposited in compounds not fully saturated, and fills up the vacancies. This attribute is most weighty for the most recent development of chemistry, as well as of great technological importance. Unawares, this property has been made use of for ages. Upon it depends the transmutation of indigo-blue in the vat into indigo-white, and, consequently, one of the oldest and most important branches of the art of dyeing.

(To be continued.)

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† Turner and Vanderpool, *Ber. Chem. Ces.*, vi., 1553.

‡ Lemery, "Memoires de l'Académie," 1700.

‖ Cavendish, 1766.

ON THE
OXIDATION OF THE ESSENTIAL OILS.
PART III.—THE LIMITED OXIDATION OF TERPENES AND CYMENE.*

By CHARLES T. KINGZETT, F.C.S., &c.

PARTS I. and II. of this research have been communicated to the Chemical Society, and will be found in the *Journal* of the Society (series 2, vol. xii., p. 511; and vol. xiii., p. 210).

The research was originally undertaken to demonstrate the nature of that active principle which was known to accompany the oxidation of oil of turpentine.

Schönbein and Berthelot and others had previously worked largely on the subject, but the nature of the principle formed was not determined correctly by either of these observers.

In my previous papers I have given the evidence on which I base my conclusion: that in the atmospheric oxidation of turpentine there results an additive compound which may be camphoric peroxide, and that this body, on coming in contact with water, splits up into peroxide of hydrogen and camphoric acid, thus:—

$$C_{10}H_{14}O_4 + 2H_2O = C_{10}H_{16}O_4 + H_2O_2.$$

Peroxide of hydrogen and camphoric acid were both determined to be present in quantity, and each body was established by analytical numbers. But the *relative* quantitative determination of these two substances was not effected, for want of material.

Among other results, I gave figures illustrative of the absorption of oxygen by other essential oils, and showed that peroxide of hydrogen also resulted when water was present.

This paper, which is to be regarded as preliminary in a great measure, contains the results I have obtained in generalising the above method of experiment to the various isomeric and polymeric terpenes, and the results of the limited oxidation of cymene. I defer the conclusions I have been led to, as to the constitution of these bodies, to a later stage in the paper, and will pass on to give the evidence I have obtained bearing on this matter.

Oxidation, by Air, of Terpenes of Formula $C_{10}H_{16}$.

(1). *Hesperidene.*

The sample experimented with was obtained by Dr. C. R. A. Wright in his researches, and kindly presented to me, with various other terpenes, &c., for these experiments.

One hundred c.c. were exposed, with an equal volume of water, to sunshine during nearly three weeks; meanwhile the terpene acquired a yellow colour, and there resulted a strongly acid solution containing acetic acid, as determined by the ordinary tests and peroxide of hydrogen. This last was determined by titrating the iodine liberated from potassic iodide, by means of hyposulphite. The total quantity contained was 0·154 grm. H_2O_2.

The residual terpene, placed with fresh water and oxi-

* A Paper read before Section B, British Association, Bristol Meeting.

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dised by a current of air at about 50° C., grew much redder in colour, and developed several successive quantities of peroxide of hydrogen, which were determined.

At the conclusion of this experiment a search was instituted for any acids that may have been produced.

The whole mixture was treated with soda solution, filtered, and treated with acetic acid, which gave a tarry precipitate and a mother-liquor.

(*a*). The *precipitate* was washed and entirely dissolved in alcohol, giving a solution which gave no precipitate with alcoholic lead acetate. The main portion of the alcoholic solution was evaporated to dryness, residue taken up with water and soda to neutrality, and filtered. The filtrate gave good precipitates with sulphate of copper and nitrate of silver, the latter being reduced on heating.

(*b*). The *mother-liquor* was exactly neutralised by pure soda, and precipitated by sulphate of copper in the cold. The precipitate, after washing, and when dried at 100° C., contained 12·85 per cent of copper.

It is thus shown that, by atmospheric oxidation of hesperidene, peroxide of hydrogen is formed, along with acetic acid and other bodies which I was not able to determine for want of material.

Wright has shown (*Journ. Chem. Soc.*, series 2, vol. xi., p. 549) that hesperidene yields, on oxidation with nitric acid, hesperisic acid ($C_{20}H_{26}O_{17}$).

(2). *Myristicene.*

(*a*). Before experimenting with the terpene of oil of nutmeg, the oil itself was oxidised atmospherically, and it was found to develop, in the presence of water, peroxide of hydrogen, and at the same time the oil became yellow and viscid.

About 200 c.c. of oil of nutmeg was employed, and yielded a solution which was unmeasured, but contained, after some exposure, 0·098 grm. H_2O_2 in 100 c.c.

(*b*). The terpene from nutmeg oil, by sodium treatment and fractional distillation, and having a boiling-point of 164° C., was next experimented with. This has been shown by Wright to consist essentially of terpene, containing persistently a trace of cymene. Thirty c.c., exposed with 60 c.c. of water to sunshine, gradually oxidised, the oil growing yellow and thick, and a solution resulting of an acid nature and containing peroxide of hydrogen at the rate of 0·0915 grm. H_2O_2 in 100 c.c.

It is to be remarked that this determination was not made until after the lapse of several weeks, hence some peroxide that formed may have been decomposed again.

(*c*). In the next experiment, the material operated upon was that fraction of the hydrocarbons derived from oil of nutmeg boiling at 173° to 175°, and, as Wright suggests in his paper, probably cymene. About 20 c.c., exposed during thirty days with about 40 c.c. of water to sunshine, gave a solution which ultimately was acid and contained at the rate of 0·0114 grm. H_2O_2 in 100 c.c. The oil had become more yellow and thick.

Wormwood.

In this experiment the ordinary oil of wormwood was used, and was originally of a reddish yellow colour. It likewise, on atmospheric oxidation in the presence of water, yielded a thick residual oil of peculiar camphor-like odour, and gave a solution containing peroxide of hydrogen.

Although the latter was only once determined, viz,, at the completion of the experiment, yet, judging by comparison tests, much of the peroxide had become decomposed in some manner during standing.

Eventually, 100 c.c. of the aqueous solution took but a few c.c. of the hyposulphite solution; but it must be borne in mind that Wright (*Journ. Chem. Soc.*, vol. xii., p. 317) has shown wormwood to consist *mainly* of an oxidised body, viz., $C_{10}H_{16}O$, although it contains some terpene.

Citronella.

This oil failed to develop any peroxide of hydrogen, even if the exposure continued over several weeks. This result I expected, knowing that Wright found this oil to consist of an oxidised body, $C_{10}H_{18}O$, and containing no free terpene.

Yhlang, Yhlang.

A sample of this oil perfume was kindly given to me by Mr. C. H. Piesse, who was engaged in some experiments upon it at the time.

Having no knowledge of its constitution, I exposed it with water to air and sunshine during a protracted period, but no peroxide of hydrogen was formed.

I have since met with an account of the constitution of this oil, by Mr. H. Gil (*Year-Book of Pharmacy*, 1874), who gives its sp. gr. as 0·980 at 15° C., and a boiling-point of 160° to 300° C. He failed to find any terpene, but discovered benzoic acid in it. These results were likewise obtained by Mr. Piesse.

The absence of a terpene in the oil strikingly accords with the non-production of peroxide of hydrogen when it is atmospherically oxidised.

Finally, in relation to this part of my subject, I will only add that the oils of carraway, bergamotte, juniper, cubebs, lemon, and chamomile likewise absorb oxygen from the air, forming, when water is present, peroxide of hydrogen; but I will not say to what extent this is the result of the oxidation of the essential terpenes, as admixture with turpentine (a not uncommon practice with druggists) would destroy the conclusions to be drawn otherwise.

Oxidation by Air of Bodies of Formula $C_{15}H_{24}$.

Clove Terpene.

Professor A. H. Church (*Journ. Chem. Soc.*, series 2, vol. xiii., p. 113) has shown that English oil of cloves contains a terpene, so-called, of $C_{15}H_{24}$ formula. This formula is supported by the vapour density of the body, viz., 7·05 (or 102 if H = 1), and a boiling-point of 253·9° (after cohobation over metallic sodium, and by re-distillation); also by its sp. gr., viz., 0·905.

It was with a portion of the terpene isolated by Church that the following experiment was performed:—Twenty c c. exposed with 2 volumes of water to air and sunshine during a period of four weeks *failed* to give even a trace of peroxide of hydrogen, neither did it alter in character, apparently, beyond acquiring a slight yellow colour. The aqueous solution was examined daily for peroxide of hydrogen.

Patchouli.

This was a sample of patchouli which, when presented to me, was described as having been subjected to a current of air until it became a thick, reddish, transparent body, of a peculiar camphor-like odour.

It failed to give any peroxide of hydrogen with water, or on renewed or prolonged exposure to air and sunshine.

Oxidation by Air of Cymene from various sources.

(*a*). The cymene first examined was derived from camphor by the action of zinc chloride. I showed, in Part II. of these researches, that 7 c.c. of this product absorbed 52 c.c. of oxygen in eighteen days, and in so doing developed peroxide of hydrogen.

This observation was confirmed by exposing a fresh portion to air and sunshine, by which means a dilute solution of H_2O_2 was obtained.

(*b*). The cymene next worked upon was kindly presented by Dr. C. R. A. Wright, whom I beg to thank for his kindness. It was derived from dibromide of cajeputol, and boiled at 176° to 177°.

By exposure of 60 c.c. with 2 or 3 volumes of water to air or sunshine an acid aqueous solution was obtained, which after three weeks contained, in 100 c.c., 0·196 grm. H_2O_2.

I was induced here to seek for *a* toluic acid, from considerations I shall state hereafter.

The aqueous solution required 30 to 40 drops of soda solution to neutralise its free acid, and the solution so obtained was of a brownish colour, giving a precipitate which seemed somewhat crystalline and partly white

(partly viscid) with hydrochloric acid. The mother-liquor was decanted, and the precipitate re-dissolved in soda and re-precipitated by hydrochloric acid, and the mixture distilled. Evidence was obtained of the presence of an acid having the characters of para-toluic acid in the distillate.

The cymene which had resulted after the oxidation experiment described was further oxidised by a current of air, in the presence of water, at about 40° C., by which more peroxide of hydrogen was produced in small, but estimable, quantities. Finally, the whole mixture was treated with pure potash, and, after agitation, filtered from the residual brown oil.

The filtrate was now concentrated by evaporation and treated with hydrochloric acid in slight excess, thereby producing a considerable precipitate in crystalline masses (needles). These were isolated, washed with cold water, and dissolved in alcohol (readily soluble), and the alcoholic solution treated with ammonia, the excess of which and the alcohol were driven off by heat.

The filtered, but still slightly coloured, solution had the characters of a toluic acid. With cupric sulphate, it gave a bulky precipitate soluble in ammonia. With argentic nitrate, it gave a white precipitate soluble in boiling water, and re-precipitated on cooling.

(*c*). The foregoing observations were repeated on a third specimen of cymene, with similar results, but in neither case did the matters obtained allow of the prosecution of analysis, being too small in quantity.

To recapitulate, I have here shown that, in the limited oxidation of terpenes, represented by the formula $C_{10}H_{16}$, peroxide of hydrogen is invariably obtained, while from such bodies of $C_{15}H_{24}$ formula as I have examined no peroxide of hydrogen results. This seems to indicate that the carbon exists in the $C_{15}H_{24}$ terpenes in an allotropic condition—a condition, by the way, it does not seem hard to bring about.

Bodies of $C_{20}H_{32}$ formula I have not yet examined. If it eventually proved that all bodies of $C_{15}H_{24}$ and $C_{20}H_{32}$ formulæ failed to develop peroxide of hydrogen by limited oxidation, it would constitute a most important and interesting diagnosis. The fact that cymene yields peroxide of hydrogen by this method is another proof that this body is the nucleus of the terpenes, and there is thus established another link between the terpenes and the benzene series.

Wright, Paterno, Fittica, and others have, by their researches, proved the identity of cymene from all sources, and attempts have been made to transform cymene into turpentine. Thus, Guareschi (*Journ. Chem. Soc.*, series 2, vol. xii., p. 684, from *Gazzetta Chimica Italiana*, vol. iii., pp. 545 to 550) attempted this conversion by means of nascent hydrogen; and, although he did not succeed, yet it will doubtless be done before much time shall elapse.

Terpene being the dihydride of cymene, and cymene, as shown by Fittica (*Deutsch. Chem. Ges. Ber.*, vol. vii., pp. 323 to 325), being normal propyl-methyl-benzene, in which the methyl and propyl occupy the *para* position, then, writing cymene as $C_6H_4(CH_3)(C_3H_7)$, its atmospheric oxidation may, perhaps, be represented by—

$$C_6H_4(CH_3)(C_3H_7)+O_6=$$
$$C_6H_4(CH_3)CO(OH)+CH_3.CO.(OH)+H_2O_2,$$

thus obtaining toluic and acetic acids and peroxide of hydrogen; while, when stronger oxidants are employed, the toluic acid becomes terephthalic acid, and hydric peroxide is not formed.

These results raise many points of the greatest importance regarding the constitution of these hydrocarbons. I hope, at a future time, to be enabled to continue these researches and to elaborate certain views which the foregoing results present to my mind.

Finally, I would point out the views of M. Berthelot (*Comptes Rendus*, vol. lxxix., pp. 1435 to 1442) as to the use of mild oxidants in studying the constitution of hydrocarbons. They are not his peculiar views; many chemists endorse them, and, indeed, I commenced my research on turpentine with somewhat similar convictions.

In the limited oxidation of hydrocarbons, he regards them as constituted of so many groups of atoms, each offering a point from which an oxidising effect can start. Thus, in the case of amylene, Berthelot considers the production of valeric acid, not as a stage in the formation of the more oxidised acids, but as a product from one particular group, amylene having five carbon groups.

It gives me pleasure to acknowledge much kind help I have received from Mr. E. L. Cleaver during the progress of these experiments.

Perhaps I may be excused for dwelling for one moment on the transformation of terpene into terebene by the action of sulphuric acid. Terpene, having a formula of $C_{10}H_{16}$, is a member of the C_nH_{2N-4} series, and yields, as we have seen, peroxide of hydrogen when oxidised under given conditions. Terebene, however, is represented by the formula $C_{20}H_{32}$, which is no longer a member of the above series, but of a series C_nH_{2N-8}. I venture to express a belief that terebene will not yield peroxide of hydrogen when oxidised in the way I have described; and, if this proves true, it would support the conclusion to be inferred from its formula, viz., that the carbon exists in an allotropic condition.

SOCIETY OF PUBLIC ANALYSTS.

"PIPER NIGRUM."

By A. WYNTER BLYTH, M.R.C.S., F.C.S., &c.,
Analyst for Devon.

Black pepper is the dried *immature* fruit of *Piper nigrum*, one of the Piperaceæ, or pepperworts. The pepperworts are a well defined natural order, confined to the hottest parts of the world, and delighting in low places, valleys, and the banks of rivers, Although neither the number of its genera nor of its species is great, yet the whole order is remarkable for a variety of active and useful plants,—*e.g.*, the aromatic black and long peppers, the astringent matico, the intoxicating *Macropiper methysticum*, the different varieties of cubebs useful in the treatment of inflamed mucous membranes, and several other plants possessing medicinal properties,* belong to the natural order Piperaceæ.

Black pepper itself is a climbing plant, attaining the height of from 8 to 12 feet; the berries—or, botanically speaking, "drupes"—are at first green, then red, and, if left still longer ungathered, turn to black; but before this latter change takes place the berries are gathered by hand and dried in the sun,—the result being an entire change of appearance; instead of a red, smooth berry, a black or reddish black peppercorn, with the cortex contracted and shrivelled in such a manner as to form a veined network, is obtained. The plant is cultivated in various portions of the equatorial regions of the earth, the zone of cultivation being confined to the isotherms of 82°: it would not, however, be strictly correct to say that this high mean annual temperature was essential, or even necessary; for the fact is that it is produced principally in the cooler valleys, where the mean annual temperature does not perhaps exceed 70° F.

The black pepper imported into this country principally comes from the islands of Malacca, Java, Borneo, and Sumatra. The commercial varieties are at least five, viz., Malabar, Penang, Sumatra, Trang, and Tellicherry, names indicating the localities from whence they are derived. The differences which these different varieties of pepper present *to the eye* are evident enough when the several samples are at hand for comparison, but it takes a

* The *Artanthe eucalyptifolia*, used in Brazil in case of colic. *Piper parthenium*, used in menstrual disturbances. *Chairca Betle* and *Sirrboa* cause salivation and decrease the function of the skin. Beside these, *Acrocarpidium hispidulum*, *Cocculus cebensis*, *Artanthe adunca*, *Chairca adunca*, and others, possess active and useful properties.

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very practiced observer to identify a solitary sample; and if samples of each of the kinds named were mixed together, I doubt the ability of any person, however "*habile*," to separate the berries again, identifying each sort with any correctness. The merchant indeed relies more upon the weight than the appearance; he takes a handful of peppercorns, and by long practice can teli in a moment whether it is a light or a heavy sample. Chevallier has determined the weight of what is technically called heavy, half heavy, and light pepper. A litre of the first weighed 530 grms.; of the second, 512 grms.; of the third, 470 grms. That there is considerable difference in weight in the different berries is certain, for I carefully weighed 100 berries of each kind, with the following result:—

		Grammes.
100 peppercorns of	Penang weighed	6·2496
100 ,,	Malabar ,,	6·0536
100 ,,	Sumatra ,,	5·1476
100 ,,	Trang ,,	4·5736
100 ,,	Tellicherry ,,	4·5076

If, then, quality is to be judged of by weight, Penang and Malabar may be bracketed together as standing first, Sumatra holding the second place, and Trang and Tellicherry bracketed together in the third. The general opinion of the trade is, I believe, that Malabar is really the heaviest, and possibly the samples of Penang which I possess are unusually fine. The whole of the ground peppers of commerce are mixtures of different kinds of pepper; there is no such thing to be found in the shops as a pure ground Malabar or a pure ground Penang. The principal varieties mixed for household purposes and retailed are Malabar, Penang, and Sumatra: the first of these is the dearest.

The usual mixture, according to Chevallier,* is—

33 per cent of Malabar to give weight,
33 per cent of Penang to give strength,
and 33 per cent of Sumatra to give colour.

The pepper thus mixed is either ground by the aid of large mill stones, or in an apparatus perfectly analogous to a coffee mill; the latter mode is far preferable to the former, as the friction of the stones developes considerable heat, and dissipates some of the aromatic principles. Pepper thus damaged by the heat of the mechanical operations is technically known as "burnt."

The microscopical structure of the black pepper berry has been accurately delineated and described by Dr. Hassall, and therefore needs no notice, as there is really nothing new to add. There is hardly anything the analyst has to examine which has a more decided and distinct microscopical structure, and all organic adulterations can be detected by a practical observer by the aid of the microscope.

The chemistry of pepper is still in a very imperfect state. Pelletier has recognised and separated piperine ($C_{17}H_{19}NO_3$), a volatile oil ($C_{10}H_{16}$), gum, bassorin, starch, an acrid resin, malic and tartaric acids, salts, extractive, and woody fibre; but there is no quantitative analysis of the whole of the known constituents. The object of this paper is to lay before the Society some observations, a portion of which has already appeared in the CHEMICAL NEWS† and in *Les Annales d'Hygiéne.*‡ On (1) the hygroscopic moisture; (2) the ash, its percentage and composition; (3) the nitrate in pepper; (4) the alcoholic; and (5) the aqueous extract.

1. *The Hygroscopic Moisture.*—This was determined by weighing about 1 gramme of the very finely powdered substance and drying in a water-bath in the usual way. Without doubt pepper dried at this heat retains a considerable quantity of water, but the very strong odour which all aromatic substances evolve at 100° C. sufficiently show that volatile principles are, during the whole evaporation, given off; it therefore is very questionable whether it is advisable to dry at a higher heat than 100° C.

The percentage of moisture is as follows:—

Penang	9·531
Tellicherry	12·908
Sumatra	10·103
Malabar	10·548
Trang	11·664

The highest percentage, then, is 12·9, the lowest 9·5, the mean of the whole 10·95.

2. *The Ash.*—In the determination of the ash about 2 grammes were placed in a large platinum dish and burnt down at a low red heat, until it was of an equally grey colour and ceased to lose weight; it was then weighed as quickly as possible, the result expressed as total ash; the ash was then dissolved in boiling water, the solution filtered, evaporated down, gently ignited, and the result expressed as soluble ash.

	Pepper dried at 100° C.		Pepper as sold.
	Soluble Ash. Per cent.	Total Ash. Per cent.	Total Ash. Per cent.
Penang	2·212	4·189	3·843
Tellicherry	3·380	5·770	5·346
Sumatra	2·626	4·316	3·334
Malabar	3·453	5·195	4·674
Trang	2·538	4·775	4·211

In all enquiries of this kind the extreme numbers are those which have the most value—the least amount of ash or the greatest amount of ash ever found in genuine samples. Now the smallest percentage of ash derived from a ground black pepper taken in its undried state that I can give is 3·3 per cent; the greatest amount is 5·3 per cent, and invariably a little more than half of this ash is soluble; it is useful to compare with these numbers those obtained by Dr. Hassall, and published in "Food, Water, and Air."

Whole Black Pepper (HASSALL.)

Sample 8	Ash	4·03 per cent.
9	,,	4·33 per cent.
10	,,	3·90 per cent.
11	,,	4·61 per cent.
12	,,	4·01 per cent.
13	,,	3·67 per cent.

Thus the greatest percentage of ash given by Dr. Hassall is 4·33 per cent., the lowest 3·9, the mean of the eleven numbers derived from the two sets of independent observations gives us the ash of a genuine black pepper, 4·17 per cent., and the conclusion is inevitable that in no case should a ground black pepper *as sold* give an ash of 5½ per cent. That the ground black peppers of commerce do give very high percentages of ash, and are therefore much adulterated, is evident from the fact that, in 16 samples of ground black pepper examined by Dr. Hassall, only one was under 5 per cent., the percentages of the other fifteen being distributed as follows:—

One	gave between	5 and 6	per cent of ash
Three	gave between	6 and 7	,, ,,
Three	gave between	7 and 8	,, ,,
Seven	gave between	9 and 10	,, ,,
One	gave between	11 and 12	,, ,,

Now, if these peppers were properly burnt, as without doubt they were, fifteen out of the sixteen were adulterated.

With regard to the composition of the ash of black pepper, the following is an analysis of the ash of Tellicherry pepper:—

	100 grammes of ash.
Potash	24·380
Soda	3·226
Magnesia	13·000
Lime	11·600
Iron	0·300
Phosphoric acid	8·470
Sulphuric acid	9·613
Chlorine	7·570
Carbonic acid	14·000
Sand	6·530

* "Du Poivre," par A. Chevallier, *Annales d'Hygiéne Publique.*
† CHEMICAL NEWS, October, 1874.
‡ "Etude Chimique sur les poivres du Commerce,, par le Dr. A. Wynter Blyth. *Annales d'Hygiene Publique*, July, 1875.

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Of all of these constituents, the sand is the most variable. The highest determination of sand which I have as yet met with occurred in a sample of Penang pepper, which gave 9 parts of sand in every 100 of ash; but if we allow that a pepper ash may contain 10 parts in every 100 of sand, how can we account for, on any theory except wilful adulteration, the fact of the ground pepper of commerce yielding to the analyst an ash one-third or one-half of which is very commonly found to consist of sand. The iron, part of which is magnetic, the alkaline earths, the chlorine, the alkalies, all vary somewhat; but there is one constituent which is extremely constant, and may be of technical utility, and that is the phosphoric acid. The phosphoric acid I find to average 8·5 per cent of the ash. I do not believe that it varies more than half a percentage either way; its determination is therefore of some value.

I may here remark that it would be of great physiological interest to bring into one view the varying amounts of phosphoric acid found in these fluids or substances which bear the name or take the place of milk. It must be remembered that the albumen of the seed, the albumen of the egg, and the milk of mammals, though so widely different in their appearance, yet all agree in one thing, that each is destined to nourish, to form materials for growth of the embryo or very young animal or plant; hence, on theoretical grounds alone, it might be predicated that such substances and fluids would be remarkably constant in their chemical composition; and I believe that with regard to seeds generally, published analyses bear this out, the element of variability that some exhibit perhaps residing in the covering portions of the seed, the cortex, and not in the seed proper, that is in the albumen and embryo. However this may be, the amount of phosphoric acid in seeds is so constant that we can hardly allow that it is stored up by mere physical agencies, but that it is the result of a vital selection of the living matter of the seed cells, whilst the lime, the sand, the magnesia, and the iron certainly show sufficient variability to suppose that a portion of these constituents is as it were accidental and not essential. It would also appear that potash or soda may to a certain extent be replaced by each other.

With regard to the arrangement and combination of the different elements found upon incineration there is much to be learnt. That the carbonic acid has no relation whatever, nor is any guide to a knowledge of the amount of carbonates existing as such in the plant, is well known, and may be proved. Thus numerous analyses of pepper ash have given me from 12 to nearly 15 per cent of carbonic acid calculated upon the ash; but pepper itself has very minute quantities of carbonate; for I have finely powdered Malabar pepper, treated it with acid, and placed it in an absorption apparatus connected with an aspirator, and drawn through the solution perfectly dried carbonic acid free air, and found that 100 grammes yielded only 0·657 milligramme of CO_2, or about 0·143 per cent of the ash; hence the 10 or 11 per cent must be produced from the organic salts, &c.

Nitrates and Nitrites in Pepper.—Comparatively few observations of the amount of nitrates and nitrites in organic substances are on record: it is a subject of some scientific interest, especially since it has been observed that nitrates and nitrites are decomposed in the presence of free oxalic acid. Whether the determination of nitric acid will be of service or not to the food analyst is unknown: it certainly may be so, if it be found that a substance rich in nitrates is fraudulently mixed with one poor in nitrates.

	Calculated as Nitric Acid. Gramme.
100 grms. of undried Penang pepper yield ..	0·04470
,, ,, Malabar ,, ..	0·03858
,, ,, Tellicherry ,, ..	0·08860
,, ,, Sumatra ,, ..	0·06560
,, ,, Trang ,, ..	0·11870

The Alcoholic Extract, obtained by exhausting a weighed sample of the dried substance by repeated quantities of boiling alcohol in a flask attached to an inverted condenser, is a fair index of the quality of a pepper, for the extract so obtained consists almost entirely of piperine and resin, the two constituents on which the qualities of pepper almost exclusively depend; nor do I believe that the advantage of separating these constituents sufficiently compensates for the extra trouble and time.

One hundred grms. of the substance dried at 100° C.:—

	Grammes.
Penang	7·650
Malabar..	6·375
Sumatra	6·450
Tellicherry	7·896
Trang	6·300

The extract, then, varies from 6·3 to 7·8 per cent.

The Aqueous Extract, containing extractive and colouring matter, soluble salts, gum, starch, and small quantities of piperine and resin, was determined by thoroughly exhausting a *small* weighed portion of pepper by a *large* quantity of boiling distilled water, and found to vary from 18 to 20 per cent.

One hundred grms. of the dried substance taken:—

	Aqueous Extract. Grammes.
Penang	18·335
Malabar	20·375
Sumatra	17·500
Tellicherry	16·500
Trang	18·175

The amount of starch in the five samples is very nearly the same—a fact easily proved by making a decoction of each, of exactly similar strength, decolourising by charcoal, then placing in Nessler cylinders, and adding an equal quantity of iodine to each; the gradations of colour are so faint that there can be hardly the difference of a percentage in the whole five: it is, however, shown in this way that Sumatra has most starch; next in order comes Penang; then Malabar, Tellicherry, and Trang, the last three containing identical quantities of starch.

Adulterations of Pepper.—Pepper has been adulterated for at least two centuries and a half, for Pierre Pomet,* writing in 1614, says:—"As the greatest part of pepper, white as well as black, is sold 'battu' (that is to say, powdered), it should only be bought of honest merchants, because all the pepper the retailers sell is no other thing, for the white, than '*des epices d'Auvergne blanches*,'† or, rather, black pepper whitened with ground rice; the black is only the dust, either of the crust of bread, grey Auvergne spices, or manignette.

The list of the adulterations enumerated by authors is an extraordinary one. Linseed meal, rice, pepper leaves, mustard, wheat flour, sago, woody fibre, chillies, rape-seed, potato, spices, capsicum, manignette (otherwise known as guinea pepper), chicory, rye, powdered leaves of the laurel which have been previously used to wrap round extract of liquorice, the stones from olives, bone dust, marine salt, and various mineral adulterations, are all said to have been selected.

However various may be the adulterations in France where Chevallier tells us in Paris alone he is acquainted with a manufactory producing 12 to 15 hundred kilogrammes annually of a mixture sold solely for the purpose of adulterating pepper, the only common adulterations of this country are what is known in the trade as P.D., H.P.D., and W.P.D., abbreviations for pepper dust, hot pepper dust, and white pepper dust; the first, or P.D., used to be principally composed of the faded leaves of autumn, but linseed meal is now preferred; H.P.D. is

* Pomet, "Histoire General des Drogues," 1735.

† "Depuis un temps immemorial le poivre en poudre sous le nom d'epices d'Auvergne, et compose de pain de cheneira et de tourteaux de faine et souvent aussi avec de la terre pourrie."—Soubeiran, "Dictionnaire des Falsifications," Paris 1874

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chiefly the husks of mustard; and W.P.D. is ground rice. To all these we must add sand, which is most certainly added; whether derived from the sweepings of the shops, or whether added as sand, is not at all clear.

Besides the formidable list of adulterations just given as found in powdered pepper, the berry itself is not free from manipulation, for as the merchant judges by the weight of the sample, means are taken to render the lighter sorts equal in weight to the heavy Malabar and Penang, and in order to do this they are macerated in tubs of brine for 24 hours, and thus impregnated with salt and water find their way into the market as Malabar; but such samples are quickly recognised by the astute merchant, and the high chlorides, the high ash, the great amount of humidity, could hardly fail to reveal their nature to the analyst.

As coffee has been cleverly imitated by chicory pressed into the shape of the coffee berry, so by pressing various pastes into the shape of the pepper berry has pepper been imitated. Of this adulteration there is the most undoubted evidence. Accum noticed artificial peppercorns made of oil cake, common clay, and cayenne pepper, and Chevallier in a recent paper states that in 1843 he was requested to examine a sample taken from 40 bales, in which he found from 15 to 20 per cent. of pepper, composed of pepper dust, bran, and other matters.

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NOTICES OF BOOKS.

A Dictionary of Chemistry. By H. Watts, B.A., F.R.S., F.C.S. Second Supplement. London: Longmans, Green, and Co. 1875.

Three years have elapsed since the appearance of the first supplementary volume to the "Opus Magnum" of Mr. Watts. During this interval, the number and the activity of chemical investigators have certainly not decreased. A second supplement has thus become necessary to bring the work up to the standard of the present year. This task, laborious from the involved necessity of examining and collating a vast mass of documents, has been performed by the author and his learned coadjutors in the ablest manner. We would call particular attention to the articles on alizarin, analysis, aniline, colours, anthracen and its allies, atmosphere, benzene, capillarity, cobalt bases, light, and phenol as being admirably digested and condensed summaries of the fruits of recent research.

Under the head of indigo, two analytical methods are mentioned which were formerly very satisfactory for commercial purposes, but which have been rendered illusory by recent improvements in fraud. The first of these is the determination of the amount of ash present, and the second is the determination of the specific gravity. Both these figures are naturally lower in a genuine sample than in one adulterated with mineral matter. But when farina is used as an admixture, they both fail. In addition to the direct information which it conveys, the work has the additional advantage of serving as a key to chemical bibliography. As an instance of its thoroughness in this respect, we need merely refer to the article on "Water." We are in no fear of contradiction if we pronounce this supplement necessary for every chemist.

American Contributions to Chemistry. An Address delivered on the Occasion of the Celebration of the Centennial of Chemistry. By Benjamin Silliman. Philadelphia: Collins.

Science is not, in its essence, national. The share taken in its development by any one country, separately regarded, is merely a splendid fragment, not an organic whole. We would gladly encourage, indeed, a noble emulation between nations in the extent and the value of their "contributions to chemistry"—or to any other branch of the interpretation of nature. We frankly congratulate America on her part in this great task. But we doubt whether the work before us is an example to be followed. Conflicting and doubtful claims are inevitable. Thus says Prof. Silliman:—"Joseph Priestley's name is immortal in the annals of our century of Chemistry. We are proud to claim him as an American by adoption, and are quite willing to adopt him with all his discoveries. A distinguished French Academician of this century once said, on presenting for the first time to the Academy of Sciences in Paris a memoir on the laws of Ohm respecting electric conduction, 'Truly, Mr. President, this is not a French discovery, but it is worthy to be made such!' So say we of Priestley and the discovery of oxygen; if it was not an American discovery it is worthy to be made such. Whom England cast out with obloquy, we accepted with cordial hospitality."

We cannot subscribe to all that is implied in this passage. That Priestley was an Englishman by descent, birth, and education, and that the bulk of his discoveries were made in England, no one will deny. That he was persecuted we admit; but can modern England be fairly blamed for the aberrations of such men as George III. and Mr. Sugar, somewhile town-crier of Birmingham? Priestley was not a "martyr of science." He suffered not on account of his discoveries. Had his life always been "peaceful and philosophic," had he never descended into the dusty arena of theological and political controversy, he would have lived and died unmolested. He was "cast out with obloquy" not by England, but by a rampant party, intoxicated with success and seeking to crush all opposition. Let us put a case to Prof. Silliman. Suppose that during the great American civil war some eminent man of science had sympathised with the south, and had advocated his cause in scores of able pamphlets. Might he not possibly have fared as ill at the hands of a Republican mob as did Priestley at those of the Birmingham roughs? Might he not possibly have been "cast out with obloquy?" Would it in such a case be fair if some European writer a century hence should charge upon America as a whole the misdeed of a party? But further; the hospitality with which Priestley was received in America, unless we are strangely misinformed, was neither unanimous nor uninterrupted. Hostile voices were not wanting, and at one time, it is said, his expulsion from the country was under contemplation, when the current was turned by the election of a new President of more liberal views.

Since, however, as we have already observed, the bulk of Priestley's researches were achieved whilst England

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and America were not distinct nations, but were still two provinces of one empire, his fame, like that of Newton, of Bacon, or of Shakspere is the joint heritage of the new country and the old.

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*Contributions to the Knowledge of Alizarin and Oxyanthrachinon.** By Conrad Willgerodt. Freiburg: Lehmann.

From this inaugural dissertation we extract the following:—

Purification of Artificial Alizarin.—The paste in question is tested in the first place for acids, salts, and for anthrachinon, and these impurities, if present, are removed by well-known methods. For without taking the acidity into account a neutral alizarate can never be obtained, since the saturation of the alizarin with potash is calculated on the dry matter in the paste. If no regard is paid to the anthrachinon, and to the salts possibly present, the alizarin may be easily supersaturated with the calculated quantity of potash, in which case the alizarate of potash cannot be separated by means of alcohol from the potash-salt of oxyanthrachinon, since in presence of an excess of potash the former dissolves in this solvent with a colour bordering on blue.

To separate alizarin and oxyanthrachinon, the paste, previously freed from acids, salts, and anthrachinon is mixed with a calculated quantity of potash, which should previously be dissolved in a little water. The resulting violet-brown mass dried in the water-bath, and finely powdered, is treated with large amounts of alcohol in a flask provided with an upright condenser. An intense blood-red colouration is first obtained. The extraction with alcohol is continued until violet extracts are obtained. The first blood-red solutions are evaporated to dryness separately. The violet liquids are strongly concentrated, when, on cooling, almost all the alizarate of potash is deposited, and only the pure blood-red solution of the potash compound of oxyanthrachinon remains. If this dried compound is dissolved in water and the solution supersaturated with an acid, we obtain a straw-coloured, gelatinous precipitate of oxyanthrachinon. By extracting the potash-compounds with alcohol an approximate quantitative determination of the oxyanthrachinon present as an impurity in the alizarin may be obtained.

The usual method of purifying alizarin, dependent on the solubility of the lime-salt of oxyanthrachinon in water was also employed by the author, and yields pure oxyanthrachinon without difficulty.

The potash compounds of the paste are dissolved in water and the solution is mixed with chloride of calcium in excess. The sparingly soluble alizarate of lime is precipitated, whilst the oxyanthrachinon salt remains in solution if a sufficiency of water is employed. The whole is filtered and the residue is washed with hot water till the alizarate of lime begins to dissolve, which may be recognised by the blue-violet colour of the liquid passing through the filter.

Hence, it appears contrary to the received notion that the lime salt of alizarin is not insoluble in an excess of hot water. The filtrate should, therefore, be allowed to stand for several days till the trace of alizarate of lime has been re-deposited. The solution, which then resumes its yellowish-red colour is then filtered, and treated with hydrochloric acid in excess, when perfectly pure oxyanthrachinon is deposited.

The following passage is important:—

The oxidation which yields alizarin is essentially due to the oxygen of the atmosphere. To prove this the author purposes, at the suggestion of Prof. Claus, to carry on futher experiments, passing atmospheric air into the melting mass. He hopes, under suitable circumstances, to convert, not merely oxyanthrachinon, but even anthracen, into alizarin.

The author gives 289°—290° C. as the melting-point of pure alizarin.

* Beiträge zur Kenntniss des Alizarins und Oxyanthrachinons.

CORRESPONDENCE.

THE HISTORY OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—The author of the very interesting articles entitled "Outlines of a Bibliography of the History of Chemistry," which have recently appeared in your columns, has referred to a small contribution of mine to the history of chemistry in the following terms:—

"Rodwell, G. F. *The Birth of Chemistry*, in *Nature*, vols. vi. and vii., 1872-73. A popular essay full of research especially rich in the knowledge of the Egyptians. It embraces only the period prior to 1680."

I venture to point out that, although the period prior to 1680 is discussed at greater length than the period intervening between that date and the time of Priestley, Scheele, Lavoisier, and Cavendish, the latter period is touched upon. For the developed theory of Phlogiston and the discoveries of Stephen Hales both belong to a later date than 1680. It is possible that Mr. Bolton has not seen the articles which appeared in *Nature* in their collected form, and may hence not have met with the last of them, which treats in brief of the theory of Phlogiston and Stephen Hales. I wish, indeed, that it were possible to speak of any history of chemistry as being "especially rich in the knowledge of the Egyptians." When we remember that the science originated in Egypt, and that the very name is derived from an Egyptian source, we can but hope that in the progress of Egyptian discovery as valuable information in regard to the history of chemistry as has already been found in regard to astronomy may be brought to light.—I am, &c.,

G. F. Rodwell.

Brancaster, September 6, 1875.

SCIENCE AT THE UNIVERSITIES.

To the Editor of the Chemical News.

Sir,—The admirable address of Prof. Vernon Harcourt to the Chemical Section of the British Association, contained in the Chemical News (vol. xxxii., p. 105), places some points in connection with the advancement of the science in a new and suggestive light; notably his proposal to organise research in scientific chemistry on a similar plan to that of the Pharmaceutical Conference in pharmaceutical chemistry; and it is to be hoped that some such scheme may be devised and carried out, as it is certain to be of great value. It is not my intention to speak at length with respect to the plan just mentioned, but to refer to one or two points in the address which one would fain hope were true, but which enquiry shows to be, at least, not entirely so. I mean his remarks with regard to the position of science at the Universities.

He says (vol. xxxii., p. 105) that the Universities (he instances Oxford more particularly, as being best acquainted with it) have "made liberal provision for the teaching of science," and the colleges have not "been backward in allotting scholarships and fellowships, . . . "but the result is somewhat disappointing, *and under a free-trade system* science has failed to attract more than a small percentage of University students." He also says of the Universities, further on, that "*with certain reserves* in favour of classics and mathematics, *their system is that of free trade.*" The italics are mine, and I believe I am in a position to show, for at least two of the Oxford colleges, Merton and Exeter—and I believe it applies to them all—that "free trade" in education is not the rule at Oxford, nor at Cambridge either.

With a view to taking advantage of the scientific teaching of Oxford, I have enquired about Open Natural Science Postmasterships at Merton, and Scholarships at Exeter. I find that all students proceeding to scientific studies are required to pass responsions and moderations, both examinations requiring classics before they can do

so; and I believe this regulation is upheld by all the colleges. Cambridge, indeed, appears to be more liberal in this respect than Oxford, science men being simply required to pass responsions.

If by the "reserves" referred to by Professor Harcourt he means these examinations, I cannot see how he can go on to speak of the University system as being one of "free trade" in the same sentence. I shall be happy to own that Prof. Harcourt is right in his representations on production of evidence to the contrary of what I have stated: but so long as men are barred entering on the pursuit of science, as there is good reason to believe they are, by the intervening classical examinations, it is not to be wondered at that the study of science at the Universities gives a "result (which) is somewhat disappointing." We must not, however, lay this to the charge of a "free-trade" system, but rather to a system which favours classics at the expense of science, and thus practically gives the former an unfair monopoly.

I believe this question to be worthy of discussion in your journal, and hope that the Universities may soon see their way clear to make their system a "free trade" one as described by Prof. Harcourt.—I am, &c.,

W. H. WOOD.

Halifax, September 6, 1875.

MR. STEWART'S "NOTES UPON SUGAR ANALYSIS."

To the Editor of the Chemical News.

SIR,—In a recent number of the CHEMICAL NEWS (vol. xxxi. p. 212) there appeared a paper by Mr. G. C. Stewart, F.C.S., Greenock, entitled "Notes upon Sugar Analysis." As I am much interested in the literature of the subject, I have examined the various statements made by the author, and have been struck by the identity of many of them in idea as well as in expression to those made by well known writers on the same subject.

If Mr. Stewart would like me to point out these passages I will do so, but perhaps he will save me the trouble by making an explanation.

As the details of the methods of analysis given by Mr. Stewart are so apparently behind date, they are not likely to be followed by chemists engaged in the examination of sugar and molasses, and therefore I will not take up your space by offering remarks upon them in the meantime.—I am, &c.,

BEET.

September 6, 1875.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—I am perfectly in accord with Mr. Collins, except on one point; namely, as to the *limitation* of the title (as he puts it) for the proposed Mineralogical Society. I am by no means alone in thinking that if there is to be such a society it ought to be *cosmopolitan*. We have the Royal Society, the Geological Society, the Chemical Society, the Geographical Society, &c.; therefore, why not the Mineralogical Society? focussed, of course, where almost everything else of importance is, in London. British and Irish mineralogists have intelligent friends all over the world.—I am, &c.,

T. A. READWIN, M.R.I.A.

Liverpool, September 7, 1875.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—On reading Mr. J. H. Collins's and Mr. T. A. Readwin's letters referring to the formation of a Mineralogical Society of England, I was quite astonished to find that a society of such kind was not established till now. In Russia, in St. Petersburg, there is only one good mineralogical museum of the Mining Institute, and the Russian Mineralogical Society, established more than fifty years, has quite enough work. In England, with its matchless collections of minerals and distinguished mineralogists, the absence of such a society may be considered as a sin.—I am, &c.,

SERGIUS KERN.

St. Petersburg, August 22, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. Vol. lxxxi., No. 6, August 9, 1875.

Experiments on Gases under High Pressures.—M. Andrews.—The distinction commonly made between a gas and a vapour rests on a basis perfectly arbitrary, and without scientific value. The author proposes to call vapour every gas considered at a temperature whatsoever beneath the critical point—that is to say, the temperature at which one cannot, by pressure alone, reduce the gas to the liquid state. According to this definition, carbonic acid is a vapour below +30°, a gas above that temperature. He has examined the properties of mixtures of nitrogen and carbonic acid under high pressures and at different temperatures. In these experiments he has gone as far as 284 atmospheres, and finds that under such circumstances the law of Dalton for gaseous mixtures does not apply. The critical point of the condensable gas in the mixture lowers, and that so much the more as the mixture contains more of an incondensable gas. Thus, in a mixture of 3 vols. of carbonic acid and 4 vols. of nitrogen, no liquid appeared at any pressure until the temperature had been reduced to −20°. In operating at temperatures above the critical point, the author has subjected carbonic acid to pressures increasing from 17 to 224 atmospheres. This gas shows great deviations from the law of Boyle or of Mariotte, and these deviations increase as the temperature lowers. The deviations from the law of Gay-Lussac presented by carbonic acid under high pressures have a great interest. The value of the coefficient of expansion (α) increases with the pressure in a manner truly remarkable. Thus, with a pressure of 40 atmospheres, and between 6° and 63·6°, $\alpha = 0{\cdot}00945$, *i.e.*, a little more than 2¼ times as much as under the pressure of 1 atmosphere. At constant pressures, the value of α changes with the temperature. In a word, the value of α, as coefficient of the elastic force, increases with the pressure and changes with the temperature.

On a Property of a Surface of Water Electrified.—M. G. Lippmann.—A mass of water unequally electrified contains at its surface an excess of oxygen proportional to the electric charge.

On the Sulpho-Carbonates.—M. Gélis.—The alkaline polysulphides do not yield, with sulphide of carbon, ordinary sulpho-carbonates of the formula CS_2,MS, but a new series of sulpho-carbonates, in which the monosulphide is replaced by an alkaline bisulphide, of which the formula is CS_2,MS_2.

Preparation of Crystalline Monobromated Camphor.—M. Clin.—The author has obtained splendid specimens of this product by the direct action of bromine upon camphor at 100°, without pressure and without distillation.

Management of Marsh's Apparatus: its Application to the Determination of Arsenic contained in Organic Matter.—M. Arm. Gautier. The author succeeds in obtaining arsenical rings corresponding, to within 1 decimilligramme, with the weight of arsenic put into the apparatus.

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Les Mondes, Revue Hebdomadaire des Sciences, No. 14, August 5, 1875.

M. Eug. Peligot has been nominated Administrator of the Assay Department of the French Mint.

M. Moigno gives a laudatory notice of the work of M. Decroix on the present consumption of horse-flesh, and on the advantages of hippophagy.

Electric Illumination.—The new iron works of M. Heilmann Ducommun are lighted up by means of electric currents, produced by the Gramme machine.

Phylloxera.—The treatment devised by M. Rohart has been experimentally tried at Montgaugé, near Chérac, and found successful. No light is thrown on the nature of the process.

Alloy of Copper Adhering to Glass.—Such an alloy may be obtained by mixing 20 to 30 parts of powdered copper (prepared by reducing the oxide with hydrogen or precipitating the sulphate with zinc) with sulphuric acid, and then with 7 parts of mercury. The whole is triturated and mixed with care. The acid is then removed by washing with hot water, and the mass is dried. After 10 to 12 hours it is hard enough to take a brilliant polish. If heated it softens, but does not contract on cooling. This alloy may be used to solder delicate articles which cannot bear a strong heat, and to stop teeth (!)

Production of Aniline Colours without the Use of Arsenic Acid.—The Tournai Company for the manufacture of aniline colours has commenced in its new works a process in which the use of arsenic is dispensed with. It appears to be Coupier's system, modified in some respects. The purity of the product leaves nothing to be desired, and it (probably magenta) is hence very suitable for the preparation of other derivatives. These colours may be used for articles of pharmacy and confectionery, liqueurs, syrups, &c.

Process for Detecting the Falsification of Fatty Oils.—M. Roth employs as reagent sulphuric acid at 46° B., saturated with nitrous gas by passing into it the fumes evolved by the action of nitric acid upon large pieces of iron. After 6 to 8 days the solution acquires a fine green colour indicative of perfect saturation. This reagent solidifies partially or totally the oleine of the non-drying oils. The purity may be judged by the time required for solidification.

Bulletin de la Societe Chimique de Paris, August 5, 1875.

Products of the Dry Distillation of Caoutchouc.—M. G. Bouchardat.—The author, resuming the line of research initiated by M. Himly and Mr. Greville Williams, seeks to establish that all the products obtained by these two chemists, as well as caoutchouc itself, are the polymers of a carbide, $C_{10}H_8$, the isopren of Mr. Greville Williams.

Synthesis of a Terpilen, or Camphenic Carbide.—M. G. Bouchardat.—Already noticed.

Chlorobromated Ethylen: Isomerism of its Chloride with the Bromide of Perchloric Ethylen.—M. E. Bourgoin.—Already noticed.

Action of the Chlorides of Alcoholic Radicals on the Primary and Secondary Monamines.—C. Girard.—The author has described, in a former paper, the action of nascent alcoholic chlorides upon diphenylamin. He has repeated the same reactions upon solid dicresylamin (*a*) melting at 77° to 78°. For this purpose he heated—in an enamelled autoclave, for 10 to 12 hours, at temperatures of 250° to 280°—a mixture of—

Solid (*a*) dicresylamin	100 grms.
Hydrochloric acid (1·17)	60 „
Methylic alcohol, pure	22 „

The pressure attained about 20 atmospheres. It was let cool, decanted, treated with caustic soda, heated gently, and then submitted to fractional distillation in vacuum. Dicresylamin *a* forming no further combination with acids, its separation from methyl dicresylamin cannot be effected by the action of a current of dry hydrochloric acid upon the benzol solution of the bases. Methyl dicresylamin is an oily mass; it does not form salts with acids. Aqueous solution of chromic acid and concentrated nitric acid merely produce a greenish yellow colouration. It is soluble in hot concentrated sulphuric acid, in alcohol, benzol, and ether. Ethyldicresylamin and amyldicresylamin have been prepared in the same manner, replacing the methylic alcohol respectively by ethylic or amylic alcohol. In their properties these tertiary monamines agree very closely. M. de Laire and the author have already pointed out that hydrochlorate of aniline is dissociated at 280° into aniline, diphenylamin, and hydrochloric acid. Taking this property as a point of departure, one of them had the idea of causing the alcoholic chlorides to react in the nascent state, in presence of water, upon the primary and secondary monamines. Thus, to obtain methyl-aniline it is sufficient to heat from 190° to 200°, under pressure, a mixture of—

Pure aniline	100 parts
Hydrochloric acid (1·17)	120 „
Pure methylic alcohol	38 „

If the proportion of methylic alcohol is doubled, very little is obtained save dimethylaniline, the substitution in this case not going further. The hydrochlorate of ammonia may be completely transformed into methylic bases by heating it for 10 to 12 hours to 260° to 270°, with an excess of methylic alcohol and a small quantity of hydrochloric acid, The reaction is so complete that it is suitable for the industrial preparation of the methylic bases.

Nature of the Astringent Principle of Mahogany.—MM. Latour and Paul Cazeneuve.—The astringency of mahogany is due to principles identical with those of catechu. Mahogany contains catechin and several congeneric or derived products of a less definite nature.

Two Isomeric Butylens obtained by the Action of Chloride of Zinc upon the Butyric Alcohol of Fermentation.—M. Nevole.—The one of these produced in larger quantities yields with bromine a bibromide boiling at 158° to 159°. The other, less in quantity, yields a bibromide boiling at 147° to 148°, and is probably identical with the pseudo-butylen of M. Boutlerow.

Determination of Sulphide of Carbon in the Alkaline Sulpho-Carbonates of Commerce.—MM. B. Delachanal and A. Mermet.—Already noticed.

Justus Liebig's Annalen der Chemie, August 5, 1875.

On Dita Bark.—Jul. Jobst and O. Hesse.—Dita is the bark of *Echites scholaris*, a tree growing plentifully in the Philippines, and is used as a substitute for cinchona bark. Its efficacy seems due to a principle named ditain by its discoverer Gruppe, and present to the extent of 2 per cent. Doubts have arisen, however, as to whether this ditain is a true chemical individual, or a mixture of two or more possibly altered products. From the crude bark the authors have obtained:—1. Ditamin, a white, faintly bitter powder, too small in quantity to permit the determination of its composition. 2. Echicantchin, a tough, yellow mass, becoming brittle at temperatures below 0°. Its composition is—

Carbon	80·64
Hydrogen	10·75
Oxygen	8·61

corresponding to the formula $C_{25}H_{40}O_2$. 3. Echicerin, a colourless substance forming acicular crystals. It contains—

Carbon	81·81
Hydrogen	10·91
Oxygen	7·28

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and may be represented by the formula $C_{30}H_{48}O_2$. Echiceric acid is an amorphous, inodorous body, easily soluble in alcohol, ether, and chloroform. Its formula is given as $C_{80}H_{46}O_4$. Further compounds obtained were echitin, $C_{32}H_{52}O_2$; echitein, $C_{42}H_{70}O_2$; echiretin, $C_{35}H_{56}O_2$; and a resinous body not examined. The authors do not consider dita bark a material likely to yield large quantities of well-defined alkaloid salts, and question its antifebrile value.

Communications from the Laboratory of Professor Lieben at Prague.—These communications consist of a paper on the synthesis of alcohols by means of chlorinated ether; account of solid benzoyl-chloride; and a notice of ethylidenoxychloride.

On Pseudo-Propyl-Rhodanide and Allyl-Rhodanide.—Gustav Gerlich.—The former of these two bodies has the composition—

Carbon	47·52
Hydrogen	6·93
Sulphur	31·68
Nitrogen	13·86
	99·99

corresponding to the formula C_4H_7SN. The latter contains—

Carbon	48·48
Hydrogen	5·05
Sulphur	32·32
Nitrogen	14·14
	99·99

Represented by C_4H_5SN.

On Phlorein, Hæmatein, Brasilein.—Rudoff Benedikt.—The results of Weselsky's researches on the azo-compounds of resorcin (see these *Annalen*, 162, p. 273) and orcin (see *Berichte der Deutsch. Chem. Gessel.*, 7, p. 439) induced the author to try the same reaction in case of certain other compounds which might possibly have a constitution similar to that of these two derivatives of benzol and toluol. The behaviour of phloroglucin seemed interesting, since, judging from the decomposition-products of morin it stands in a close relation to resorcin. He has, in fact, succeeded in converting phloroglucin into a colouring matter, not, however, analogous with the diazo-compounds of Weselsky, but rather with two other well-known colouring matters, hæmatein and brasilein. Hence, he proposes to name it phlorein. It must be added that the author has discovered and determined nitrogen in both hæmatein and brasilein, and assigns to the former the formula $3(C_{16}H_{13}O_6)N$, and to the latter that of $3(C_{22}H_{17}O_7)N$.

Three New Pinacolins.—A. Wischnegradsky.—The three bodies in question are ethyl-butyl-pinacolin—

$$C(CH_3)_3COC_2H_5;$$

methyl-amyl-pinacolin—

$$C(C_2H_5)(CH_3)_2COCH_3;$$

and ethyl-amyl-pinacolin—

$$C(C_2H_5)(CH_3)_2-COC_2H_5.$$

Derivatives of Acetylen.—A. Sabanejeff.—The author examines the action of bromine upon acetylen, and the resulting compounds: acetylen-tetra-bromide, solid tribrom-ethylen, and acetylen-dibromide. He remarks that a main condition for the preparation of acetylen-dibromide by the reaction of bromine and acetylen, lies not so much in strongly cooling the bromine as applying it in dilute solution and keeping the acetylen in excess.

The action of iodine upon acetylen yields three compounds; a very volatile iodide not yet examined, a solid and a liquid.

The author is examining also the behaviour of acetylen with alcoholic potash, alcoholic ammonia, acetate of potash, acetate of silver, alcoholic potassium cyanide, and mercury cyanide, sulphite of ammonia, sulphides of potassium and ammonium, and of aniline.

MISCELLANEOUS.

Anderson's College, Glasgow.—Mr. E. J. Mills, D.Sc., F.R.S., has been appointed Young Professor of Technical Chemistry in this College, Prof. Gustav Bischof having resigned.

United States Board, appointed to Test Iron, Steel, and other Metals.—The Committee on Corrosion of Metals of the United States Board, appointed to test Iron, Steel, and other Metals, asks the assistance of all whose tastes, interests, or occupations have induced them to note the rate and mode of destruction (by corrosion) of the metals used in construction. Full and clear statements are required of all cases observed which show a remarkably rapid rate of corrosion or the reverse. It is very desirable, whenever practicable in these cases, to get a sample of the metal and of the scale or crust formed, for the purpose of chemical analysis. These samples may be forwarded to Col. T. T. S. Laidley, President of the Board, at Watertown Arsenal, Watertown, Mass., accompanied by a full statement of all the known conditions which have influenced the rate of corrosion in the particular case observed. The samples so forwarded will be carefully analysed. Important as the subject of the corrosion of metals is, the information touching it is so meagre and indefinite that the rate of destruction cannot be predicted with certainty in any given case. The Committee ask to be referred to such sources of information as may be deemed valuable—such as reports of engineers, architects, and scientists, or articles touching this subject contained in scientific publications. The Committee consists of—Wm. Sooy Smith, C.E., Chairman, Maywood, Illinois; Lieut.-Col. Q. A. Gillmore, U.S.A., Army Building, New York City; Com. L. A. Beardslee, U.S.N., Washington, D.C.

NOTES AND QUERIES.

Chrome-Iron Alloy.—Can any of your readers give me more information on the matter than is contained in the article on page 136 of your present volume. From whom can the ore be obtained? —G. G. B.

TO CORRESPONDENTS.

*** We cordially thank those gentlemen who kindly sent us information respecting the Chemical and Medical Schools for our Students' Number.

G. Valentine.—Consult "Select Methods in Chemical Analysis," published by Longmans and Co.

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THE CHEMICAL NEWS.

Vol. XXXII. No. 826.

THE ROYAL COMMISSION ON SCIENTIFIC INSTRUCTION.*

II.

The facts elicited by the Commission prove that in their opinion, and most assuredly in ours, "Science is as yet very far from receiving the attention to which it is entitled" in our public and endowed schools. "Even where science is taught, from one to two hours' work per week may be regarded, with very few exceptions, as the usual time given to it in such classes as receive scientific instruction at all. Among the 128 endowed schools from which we have received returns, science is taught in only 63, and of these only 13 have a laboratory, and only 18 apparatus, often very scanty. Out of the 128 schools 30 allot no regular time whatever to scientific study; 7 only one hour a week; 16 only two hours; whilst out of the whole number only 18 devote as much as fours hours to it. The neglect with which it is treated is also clearly shown by that portion of the Assistant Commissioner's Report in which the weight attached to science in the school examinations is stated, whence it appears that among the higher grade schools from which information has been received, *only two* attach a weight to science in the examinations equal to that of classics or mathematics, while in the case of the 128 endowed schools from which information has been received only 13 give any weight at all to science in the examinations."

Hence it would appear that England, in 1875, is about on a level with Germany in the year 1820, before the great impulse given to scientific education by Liebig and his contemporaries. We are half a century in the rear, and are not yet even agreed as to the best means of recovering this amount of lost ground!

If we examine the causes of this alarming and dangerous neglect, we come first upon the vulgar notion that science, if needful, may be "picked up" at any time, and need not, therefore, be introduced into the educational course of our schools and colleges. Now that a smattering of science may thus be picked up at hap-hazard we do not deny. But no amount of mere reading will give a man a sound acquaintance with any science—much less qualify him to enter upon original research. For these purposes actual work under an experienced instructor is absolutely necessary.

Another prevailing delusion is, that whilst classics and mathematics have a high and peculiar value as means of mental discipline, independently of any special application they may admit of in the pursuits of the student, science has no such value.

Against this view we hold that it is difficult to protest too emphatically. The main business of life, as far, at least, as the conduct of the intellect is concerned, may be said to consist in drawing correct conclusions from facts carefully observed. For this double purpose, we hold that the different branches of science, physics, chemistry, or biology, furnish an admirable training. The classicist fixes his attention upon words rather than upon things. He does not learn to discriminate between minute gradations of colour, texture, or form. The mathematician may reason admirably, but from the same neglect of the powers of observation he is exceedingly apt to build his arguments upon an unsound basis. For a perfect education, language, mathematics, and physical science are all necessary. But the last-mentioned is certainly not less important than the two former; nor, if one of the three must be omitted, is it the one which we should doom. Better a man should be able to tell us new and important truths, even in clumsy and inelegant language, than that he should repeat errors and absurdities in the most faultless periods.

The Commissioners, in our humble opinion, scarcely go far enough in their recommendations. They do, indeed, "insist on the introduction of scientific training as an integral part of school education." They propose that in all public and endowed schools a substantial portion of the time allotted to study should, throughout the school course, be devoted to natural science; and are of opinion that not less than six hours a week on the average should be appropriated for this purpose, and that in all general school examinations not less than one-sixth of the marks be allotted to natural science."

"Half a loaf," says the old proverb, "is better than no bread," and we must, therefore, look upon this proposal with due thankfulness. But we think that natural science might well claim, not one-sixth, but one-third, of the examination marks. So long as it can command merely one-sixth, students whose tastes and mental peculiarities incline them to the special study of any department of physical science will find themselves heavily handicapped in comparison with those of their comrades of a more literary turn.

The Commissioners further recommend that "students at the Universities should at an early period, if not from the commencement of their academical course, be left free to choose for themselves among the principal lines of study, and should not be hampered by being compelled to pass examinations in subjects having no direct bearing upon their subsequent career."

This sounds refreshing, but it is hampered by one of those saving clauses which so often mar the effect of laws and recommendations:—"But we make this recommendation conditionally; that is, upon the understanding that the student should be well grounded in the principal branches of knowledge before his entrance into the University, asserting that literary cultivation up to a certain point is indispensable for the scientific student."

Up to what point? Is it not perfectly conceivable that a man might display the highest merit in chemistry, physics, or biology, and yet be totally ignorant of Greek and Latin? Would not the fairest method be to grant degrees—or, if deserved, honours—in any one branch of knowledge which he might select, totally irrespective of his proficiency or non-proficiency in other spheres?

We have not the least intention of undervaluing literature in general, or classical study in particular. But we cannot help regarding it as a neighbour from whose encroachments science has hitherto suffered, and which it is very important to confine for the future within reasonable bounds.

* "Sixth, Seventh, and Eighth Reports of the Royal Commission on Scientific Instruction and the Advancement of Science." London: Printed for Her Majesty's Stationery Office, 1875.

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THE AUGMENTATION OF THE CHEMICAL ACTIVITY OF ALUMINIUM BY CONTACT WITH A MORE NEGATIVE METAL.*

By Dr. J. H. GLADSTONE, F.R.S., and ALFRED TRIBE.

Having had occasion to employ aluminium for effecting certain decompositions, we were induced to determine whether covering its surface with more negative metals would so augment its chemical affinity as to enable it to decompose water below or at 100° C.

According to Deville, the metal *alone* only decomposes water at a white heat.

The following experiments were made:—

(*a*). 0·43 grm. of metallic copper was deposited upon 6 grms. of aluminium foil (126 c.m. long, and 5 c.m. wide), in a 2 oz. flask, by immersion in very dilute copper sulphate, very slightly acidulated with hydrochloric acid. The couple so obtained was completely freed from sulphate and chloride by washing with pure water.

(*b*). 0·2214 grm. of platinum was deposited upon a similar quantity of foil by immersion in dilute platinic chloride, and was washed as in the former instance.

The results obtained were as under:—

Temperature.	Time.	AlCu Experiment.	AlPt Experiment.
12° C.	22 hours	2·5 c.c.	4 c.c.
100	next 6 ,,	375·0 ,,	484 ,,
100	,, 6 ,,	92·0 ,,	114 ,,
100	,, 6 ,,	55·0 ,,	78 ,,
100	,, 6 ,,	33·0 ,,	45 ,,

The flasks containing these preparations were filled with water, and after standing twenty-two hours at ordinary temperature, were heated to 100° C. The fact brought out by the above experiments was further established by other decompositions, and is, of course, corroborative of our work with zinc conjoined to more negative metals in a spongy condition.

NOTES ON THE ACTION OF THE COPPER-ZINC COUPLE.*

By Dr. GLADSTONE, F.R.S. and ALFRED TRIBE.

Relative Activity of Pure Zinc, and Zinc Covered with Spongy Copper.

A solution of sulphuric acid containing 3½ parts of acid to 1000 of water, is just acted upon by pure zinc.

In an experiment with 2·5 grms. pure granulated zinc immersed in acid of this strength, seven volumes of hydrogen were evolved in one hour.

In another experiment in which the same piece of zinc upon which 0·003 grm. of copper had been deposited, was used, eighty volumes of gas were given off in the same time.

Thus it appears that the activity of zinc in very dilute sulphuric acid is increased eleven fold by less than 0·12 per cent of the negative metal.

Arseniuretted Hydrogen.

If zinc containing arsenic be acted upon with dilute sulphuric acid, the hydrogen evolved will, as is well-known, contain AsH_3; the formation of which is explicable (from analogy with what is known of the action of hydrogen upon oxy-nitrogen compounds) on the supposition that the arsenic becomes dissolved, and that by the subsequent action of hydrogen upon the arsenical compound in solution, the arseniuretted hydrogen is produced.

Some four years ago we pointed out that the copper-zinc couple in presence of water effects the decomposition of that fluid, zinc hydrate and hydrogen being produced.

According to Bousdorff, arsenic does not dissolve in water free from dissolved oxygen—a fact which we have verified—and also that dilute sulphuric acid does dissolve it.

Now if the foregoing view of the formation of the AsH_3 be correct, the hydrogen obtained by the action of the couple upon water should be free from arsenical gas, even though the couple be made with arsenical zinc.

We give the results of four experiments. A quantity of arsenical zinc foil was "coupled" with copper washed and heated with water, and the two litres of gas evolved passed through a tube heated to redness. Not a trace of arsenic was noticeable.

Another portion of the same foil was treated with dilute sulphuric acid, and two litres of hydrogen given off passed through a tube heated as before. 0·0019 grm. of arsenic was deposited in the cool part of the tube.

The same zinc "coupled," when treated with dilute sulphuric acid, gave arseniuretted hydrogen, which appears to point to the conclusion that it is not the presence of the copper, but the inability of the arsenic to get into solution that accounts for the absence of arsenic in the gas obtained from water and the couple, a conclusion confirmed by adding a dilute solution of arsenic (1 part of As_2O_3 in 12,000 water) to same couple, when immediately the arsenical mirror was produced in the heated tube.

* Read before the British Association, Bristol Meeting, Section B.

PRODUCTION OF SULPHURIC ACID.

Mr. Hermann Sprengel's application of atomised liquids in operations where a liquid is made to act as an absorbent of a gas possesses great advantages. The method has been applied with success to the purification of coal-gas, and to the condensation of hydrochloric acid, and by its use great improvements in the production of sulphuric acid have been affected. It is well known that sulphuric acid as contained in the chambers contains about 50 per cent of water and that all this water was once steam, and was taken as such from the steam-boiler. Before being condensed in the chambers this steam occupied a certain space, and moreover helped (on account of its heat) to expand the bulk of the other gases used in the formation of sulphuric acid. In winter time the yield of acid is better, and the consumption of nitre less, than in summer time; and the greater the chamber-space (*i.e.* the smaller the volume of gas allowed to pass the chambers in a certain time) the less will be the consumption of nitre (in proportion to the acid produced) and the easier will be the conversion of all sulphurous into sulphuric acid.

Hence, as the *lowering* of the temperature of a gas necessarily implied the *shrinking* of its volume, both of which favour the process of sulphuric-acid-making, Mr. Sprengel commenced to manufacture sulphuric acid by means of what has been called "*pulverised or atomised water or spray*," which he injects into the chambers as a substitute for steam. This effects (1) a saving of fuel equal to the amount which is required to convert this pulverised water into steam, and (2) a cooling of the chambers equal to the loss of the amount of heat which would have been generated by the combustion of the coal thus saved.

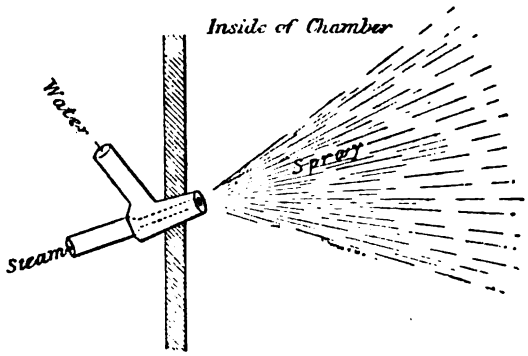
The spray is produced at present by means of "some" steam, which is made to escape from a platinum-jet under a pressure of about 2 atmospheres into the centre of a flow of water, as shown in the figure.

20 lbs. of steam will thus convert 80 lbs. of water into a cloud-like mist, the actual weight of which, issuing from a jet of the above size, amounts to about ¼ ton in twenty-four hours. These jets are placed in the sides of the chambers about 40 feet apart. They are supplied with water from a tank above, while the steam is taken from the steam-pipes already existing between the chambers, or better from smaller ones put in their place.

At the works of the Lawes Chemical Manure Company the saving in coal amounts about two-thirds of the quantity

formerly burned. It is generally believed that a moderate temperature favours the formation of sulphuric acid, but Mr. Sprengel has found that the stronger the frost the better was the condition and the yield of the chambers.

The "spray-acid" has been produced with 6½ per cent less pyrites and with 14¾ per cent less nitre than the "steam-acid," which was made from the same material during the two years preceding the application of the spray. These numbers, moreover, refer to the yield of chambers without Gay-Lussac and Glover towers.



In factories where these towers are in use the saving will be probably one-third less, at least as far as steam is concerned. But as it is believed that a considerable proportion of nitrous acid becomes destroyed in the Glover tower by the heat of the gases from the kilns (*i.e.*, broken up into oxygen and nitrogen), Mr. Sprengel thinks that for the sake of coolness this acid is better distributed in the interior of the chambers as spray. The Glover tower of course will still serve as an admirable instrument for concentrating chamber acid.

At the works of the Lawes Chemical Manure Company the construction of the apparatus came to about £10 per chamber, while the savings in steam, acid, nitre, and labour during three months amounted to 5*s. per ton of acid of* 1·6 *sp. gr.*, made from pyrites.

No doubt different localities, different care, and different prices will lead to different results. But even if the savings should elsewhere be considerably less, the result will still appear acceptable, considering the simple and inexpensive means by which it has been attained and the large consumption of the article which it helps to cheapen, for 1s. per ton saved or wasted means, with reference to England's annual consumption, about £50,000.

THE POSITION AND CHARACTER OF MERCURY AND COPPER, FOUNDED UPON THEIR ATOMIC WEIGHTS.

By C. T. BLANSHARD, F.C.S.

AFTER reading the valuable article by Mr. Newlands in the CHEM. NEWS, vol. xxxii., p. 21, which I have only lately had the opportunity of seeing, there seem to be some anomalies in the hypothesis of chemical properties being dependent on atomic weight, atomic volume, &c., that require explanation.

Mercury and copper are two well-known metals, which behave equally as monads and dyads, with essentially different properties according to their atomicity in the compound.

Mendelejeff, one of the first to work at this subject, gave in vol. 2 of his "Modern Chemistry" (Petersburg, 1873), a table of the elements classified according to their atomic weights, it being in fact the very table whose absence from our text-books Mr. Newlands laments. In this table 100 is put down from calculation as one of the missing numbers. Again, this number might, as Newlands shows, represent a monatomic element. This missing element I take to be mercury acting as a monad. For when diatomic mercury has the atomic weight 200, or more accurately perhaps 199·8, as given by Mendelejeff, the monad would be represented by 100.

I hope to show that mercury with this atomic weight has a legitimate place amongst the elements, as distinct from the metal whose atomic weight is 200.

(1.) Mercuric chloride is soluble in water, Hg″ belonging to the natural group, zinc, cadmium, and mercury, the representatives of which are more volatile as the atomic weight increases (their specific heats and other physical properties also show that they form a natural group); whilst mercurous chloride is insoluble in water, being analogous to silver chloride.

(2.) Mercury = 100, and silver = 108, each heads a group of elements arranged according to increasing atomic weight and valency (*vide* CHEM. NEWS, vol. xxxii., p. 21.)

(3.) The number 100 being not very different from 108, similar properties may be expected in the elements, as is frequently the case, *e.g.* nickel, cobalt, and iron; cerium and lanthanum, &c.

(4.) On referring to *Annalen der Chem. u. Pharm.*, Supp. vii., p. 380, it will be seen from Meyer's table of curves, the ordinates giving the atomic volumes, the abscissæ the atomic weights, that with the atomic volume 7·35 (Hg′ = 100) mercury, the monad, occupies a position at the lower apex of a curve, where according to Meyer's laws for the curves it should have the properties of being easily liquefiable and heavy, as mercury undoubtedly has. Again, it occupies here a similar position to monatomic copper in the curve preceding.

So, then, the properties of mercury as a monad, its atomic weight, and its atomic volume, whether derived from theory or experiment, agree together to show that this element should have the position here assigned to it in Meyer's curve; and further, the chemical properties of the monatomic metal are explained by reference to its atomic weight, equally well with other known elements, diatomic mercury included.

As regards copper, both Mendelejeff and Newlands regard this metal as being normally a monad. This view is entitled by the atomic weight, just less than that of the diad zinc, and by the existence of such compounds as the hydride (CuH), and the vinyl compounds (C_2HCu_2)O and (C_2HCu_2)(OH), strictly analogous to the silver compounds (quoted from Berthelot in *Journ. Chem. Soc.* for last month). The relation of copper to silver and monatomic mercury being explained by reference to the atomic weight, the diad nature of copper remains to be accounted for on this hypothesis.

If it be correct to take the atomic weight of diatomic copper as double that of Cu′, *i.e.* 126·6, then the position of copper both in Meyer's curve and in the scale of classification by atomic weights, becomes apparent. Cu′ = 126·6 has the atomic volume 14·4. It will then occupy the position of a metal in the curve between the triad antimony and the monad iodine; copper being on the falling part of the curve as a metal, and a difficultly fusible body, whilst tellurium, with nearly the some atomic weight, has a normal position on the rising curve as an electronegative body. Meyer marks the position of tellurium as abnormal, but giving it an atomic weight of about 126, it will just precede iodine, as selenium just precedes bromide on the adjoining curve.

If this be the true view, then there are two diads (or exhads) coming between antimony and iodine. This is not unparalleled, as nickel and cobalt, two metals of the same atomicity and the same atomatic weight (as far as experiment has yet shown) occupy one position in the group with iron. Mr. Newlands has represented cobalt as a monad or heptad in his table, but this is perhaps an erratum, as the analysis of cobalt compounds would hardly admit of such a view.

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I trust that these remarks will help to confirm the truth of the hypothesis put forth by Newlands and others, by accounting for some apparent anomalies; and that they will show that the properties of the so-called elements are related to the numbers themselves that represent their atomic weights and atomic volumes, rather than that the elements admit of any mere linear classification.

Leamington, September 16, 1875.

ON THE ACTION OF PHOSPHORUS PENTACHLORIDE ON ACETAMIDE.

By RALPH W. EMERSON MAC IVOR, F.C.S.,
Andersonian University, Glasgow.

THE *Journal of the Chemical Society* for the present month contains an abstract of a paper on the "Action of Phosphorus Pentachloride on the Acid Amides," by O. Wallach, published in *Deut. Chem. Ges. Ber.*, viii., 299-309, in which that chemist denies the statement, made by Henke, to the effect that PCl_5 acts violently on acetamide. Wallach states that the two compounds scarcely act on each other in the cold, only a small quantity of acetamide hydrocloride being formed; if the reaction takes place in chloroform, it becomes violent, but the product is the same, and when the amide and pentachloride are heated together for some time, they yield acetonitril, together with phosphorus trichloride and oxychloride. Some time ago I made a few experiments on the subject, and obtained results which fully confirm those arrived at by Wallach.

SOAP DIRECT FROM COMMON SALT.

By T. N. WHITELAW.

WHEN any fatty or resinous body commonly used in soap-making is heated with excess of common salt, ammonia, and water, soda-soap forms and separates, while the solution contains the excess of ammonia and common salt, together with ammonium chloride. Thus, with stearic acid:—

$$H\overline{St} + NaCl + NH_4HO = Na\overline{St} + NH_4Cl + H_2O.$$

This reaction depends on the ready solubility of ammonia-soap in water containing ammonia, and the insolubility of soda-soap in water containing more than 0·5 per cent of sodium chloride.

The ammonium first combines with the fatty acid—

$$NH_4HO + H\overline{St} = NH_4\overline{St} + H_2O,$$

but immediately exchanges with the sodium of the common salt—

$$NH_4\overline{St} + NaCl = Na\overline{St} + NH_4Cl.$$

As explained above, an excess of ammonia and salt is requisite; 100 parts of fatty matter require from 15 to 20 parts of NH_3, 20 to 30 parts of salt, and 200 to 300 of water.

The Germans make soap on a similar principle, potash-soap being first formed, then decomposed with common salt; but by this process the resulting soap contains soda and potash in nearly equal quantities, the decomposition being incomplete.

With ammonia, however, the reaction is nearly complete, about 9-10ths of the base being soda; and one can easily remove the remaining 1-10th of ammonia by washing with water containing common salt; there then remains a soap with part of the acid unsaturated.

Resin-soap, formed in this way, contains almost the full quantity of soda, but the completeness of the reaction depends greatly on the amounts of ammonia and salt relative to the fatty matter, a slight variation in these altering considerably the product.

When one uses free fatty acids or resin, the formation of soap occurs at once, on simply heating in a closed vessel slightly above the melting-point of the fatty acid or resin and agitating. But, with neutral fats, the case is different; it is then preferable to heat the ammonia solution and fat to 150° C. in a closed vessel, when ammonia-soap and glycerine form; the ammonia-soap can then be decomposed with sodium chloride as before described.

The action of ammonium chloride on common soap is peculiar, and such as would lead one to expect that the above formation of soap with the aid of ammonia could not occur. It does not separate soda-soap from solution, after the manner of common salt (as is usually stated in works on soap-making), but, on heating, evolution of ammonia takes place, and when sufficient salt forms, by the combination of the sodium of the soap with the chlorine of NH_4Cl, an acid-soap separates; on prolonged boiling, the soap is completely decomposed, common salt remaining in solution and fatty acids floating on the surface.

The process might, practically, be of some value; it has the same difficulty to contend with as that for the conversion of common salt into sodium carbonate with the aid of ammonia, and that difficulty, the chance of losing ammonia would probably be much less. Allowing 5 per cent loss of NH_3 in each complete operation, the alkali in soap would still be considerably cheaper than by the present methods.

Again, the salt at present lost in the operations of soap-making, with the labour and fuel of alkali-making, would in great part be saved.

Sidney Street, Glasgow,
Sept. 6, 1875.

ON THE RADICAL AMMONIUM.

By SERGIUS KERN, St. Petersburg.

THE radical ammonium (NH_4), according to Weil (*Pogg. Ann.*, cxxiii., p. 350), may be obtained by the action of ammonia gas in sealed tubes on a mixture of metallic potassium with a salt of ammonium (NH_3HCl); a dark blue liquid is obtained, existing only at a high pressure and yielding easily at a higher temperature free ammonia and hydrogen. Some chemists explain the formation of ammonium in this way by the following process: the ammonia first combines with the ammonium chloride, and on this compound the metallic potassium then acts, yielding free ammonium. But the existence of a compound of NH_3 with NH_3HCL cannot be adopted, as proved by experiment.

In further experiments it was remarked that the liquid contained a considerable quantity of amido-potassium (NH_2K), and the blue colour of the liquor is thus very easily explained, as the NH_2K represents in a fluid state a blue coloured liquid. The reaction which takes place is the following; it explains also the presence of free hydrogen in the tube:

$$NH_3HCL + 4K + 2NH_3 = 3(NH_2K) + KCl + 2H_2.$$

The presence of ammonia in free state, and the change of colour of the product in the tube into a solid brownish-green mass may be ascribed to the decomposition of amido-potassium, which, as it is known, decomposes by the following equation:—

$$3(NH_2K) = NK_3 + 2NH_3,$$

These experiments I suppose prove that the production of free ammonium by this process is doubtful, and that the formation of ammonium is till now an open question. Numerous experiments were made with ammonium-amalgams, but by these means the studying of the properties of ammonium is impossible, owing to the instability of the compounds obtained. By acting on a mixture of cuprous sulphate (Cu_2SO_4) and ammonium chloride by

means of a powerful battery an alloy of copper and ammonium was obtained on the negative pole, containing not more than 1 per cent. of ammonium in the form of a greyish-red spongy mass. The experiments made with this alloy were very unfortunate, and the attempts to isolate the ammonium showed only the probability of obtaining ammonium in a form of a solid mass resembling the metals of alkalies.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 139.)

In 1842, Zinin succeeded in converting nitrobenzol into aniline by the action of nascent hydrogen, and thus opened out an industrial region of unimagined extent. The era of the artificial dyes followed. It was soon perceived that many of these substances shared with indigotin the property of being decolourised by hydrogen, and thus zinc-powder was introduced into calico-printing as a discharging agent, which, developing hydrogen in patterns where it is printed on, removes artificial colouring matters, *e.g.*, magenta.†

A series of interesting observations showed, however, that the manner in which hydrogen is evolved is not without influence on hydrogenisation. Whilst ammonium sulphide, and whilst acids under the influence of metals give up so much hydrogen to nitrobenzol as to form aniline, if other sources of hydrogen are employed the reaction is arrested half-way and intermediate products are generated. Herewith, therefore, nascent hydrogen escapes from our general consideration, and its technical application will be described in future parts of this report.

We return, therefore, to its applications as a source of heat and light. It has been briefly described in the section on oxygen how the oxyhydrogen blast was evolved from the experiments of Saron between 1780 to 1790, and how it was introduced in the manufacture of platinum in the middle of the present century by Deville and Debray. Since 1838‡ Desbassains de Richemont found in hydrogen mixed with air the means for the autogenous soldering of sheets of lead, and thus supplied the sulphuric acid manufacture with the fundamental condition of its growth, *i.e.*, permanent lead chambers of any desired magnitude. If, in places where coal-gas is readily procurable, this combustible is substituted for hydrogen in soldering lead, many sulphuric acid chambers are not near gas-works, and in them hydrogen is still necessary for soldering. The same must be said on the application of hydrogen for the autogenous soldering of other metals and alloys, a process for which Winckler, in his convincing essay already quoted, predicts a great future. More recently, lead pans soldered in this manner have been introduced in the manufacture of boracic acid in Italy. Numerous conflagrations, especially that of Canterbury Cathedral in 1871, and that of the Alexandra Palace on Muswell Hill in 1873, demonstrably due to the braziers full of fire used in soldering the leaden spouts, have led, in England, to the proposal to solder leaden roofing and spouting with hydrogen.

How far hydrogen is superior to other kinds of fuel appears from the following table. According to the experiments of Favre and Silbermann, 1 grm. of the following bodies, when burnt in water, gave the appended number of calories, *i.e.*, it raised, by 1°, the temperature of the given number of centigrammes of water.*

Hydrogen	34·462
Carbonic oxide	2·403
Oil of turpentine	10·852
Stearic acid	9·716
Alcohol	7·814
Marsh-gas	13·063
Wood charcoal (burnt to carbonic acid)	8·080
Ethylen	11·858
Ether	9·028

(To be continued.)

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† The transformation of the coloured salts of rosanilin into the colourless salts of leucanilin by means of zinc and hydrochloric acid was discovered by A. W. Hofmann in 1860.—*Proc. Roy. Soc.*, vol. xii., p. 2. The above application is due to Durand. See Schützenberger, "Traité des Matières Colorantes," vol. i., p. 491.

‡ Karmarsch, "Geschichte der Technologie," 380.

* A. Würtz, "Dictionnaire de Chimie," vol. i., pp. 825, 82

SOCIETY OF PUBLIC ANALYSTS.

The following communication from the Secretary of the General Post-Office will be of interest to Public Analysts:—

General Post-Office, September 16, 1875.

Sir,—With reference to your letter of the 13th instant, I beg leave to forward you, in compliance with your request, the enclosed copy of the regulations relating to the conveyance and delivery by post of packets addressed to Public Analysts under the provisions of "The Sale of Food and Drugs Act."—I am, Sir, your obedient servant,

John Tilley, Secretary.

G. W. Wigner, Esq.,
Hon. Sec. Society of Public Analysts,
79, Great Tower Street, E.C.

Instructions in Connection with "Sale of Food and Drugs Act."

Under the provisions of the 16th Clause of the "Sale of Food and Drugs Act," 38 and 39 Vict., c. 63, which is appointed to come into operation on the 1st of October next, the following regulations have been laid down by the Postmaster-General, in regard to the conveyance and delivery of such articles as are permitted by the Act to be forwarded to duly-appointed Analysts as registered letters through the post:—

1. Each packet must be addressed according to the Official designation of the Analyst, as "Public Analyst" or otherwise, and the nature of its contents must be stated on the front of the packet.
2. Any Postmaster, at whose Office a packet for a Public Analyst shall be tendered for registration, may refuse to accept it for this purpose, unless it be packed in so secure a manner as to render it at least unlikely that its contents will escape and injure the correspondence.
3. Liquids for analysis shall be contained in stout bottles or bladders, which shall be enclosed in strong wooden boxes with rounded edges—the boxes being covered by stout wrappers of paper or cloth; and no such packet shall exceed 8 inches in length, 4 inches in width, or 3 inches in depth.
4. No packet whatever addressed to a Public Analyst shall exceed the dimensions of 18 inches in length, 9 inches in width, or 6 inches in depth.

The postage and registration fee on each packet must, of course, be prepaid.

By command of the Postmaster-General.

General Post-Office, 6th September, 1875.

THE COST OF PUBLIC ANALYSTS IN IRELAND.

Dr. Cameron, Public Analyst for the county of Kildare, reported to the Grand Jury at the last meeting that he had made 63 analyses of food during the year, of which 17 had been adulterated: 14 adulterators were convicted,

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and the fines, exclusive of costs, amounted to £45, which sum had been paid over to the county treasurer. As the Analyst's salary is £30 a year, the county made £15 nett on his operations. Kildare is a small, purely rural, county, containing no town of more than 4000 inhabitants.

NOTICES OF BOOKS.

Fifth Annual Report of the Deputy Master of the Mint, 1874.

From this report we learn that experiments in connection with spectroscopic assaying have been continued during the past year. Of these one of the most interesting has been "the verification of the degree of purity of the fine gold trial plate, by comparing it with the solar spectrum." It was already known that the plate did not contain any impurities which could be detected by ordinary analytical methods, and it appears that the gold withstood the more delicate test of the spectroscope, no impurity being found present. A map of the gold spectrum as compared with the solar spectrum is now in course of preparation.

The total number of assays executed has been 2521 of gold and 7917 of silver. No gold was set aside during the year on account of brittleness.

In the special report of Mr. Chandler Roberts, the able Chemist to the Mint, reference is made to the volumetric method of assaying silver by means of hydrobromic acid, as described by M. Stas and to Volhard's new volumetric assay. This latter method is based on the fact that silver is entirely precipitated from solution by soluble sulphocyanides. An acid solution of nitrate of silver is used containing a little sulphate of iron, and the completion of the process is indicated by the appearance of a blood-red colour. This method is pronounced "rapid," accurate, and well adapted for the assay of alloys containing more than 70 per cent of silver."

Monthly Report of the Department of Agriculture, for February and March, 1875. Washington: Government Printing Office.

In this interesting report we notice a strange, and in our opinion a very unnecessary, discussion as to the comparative value of farm-yard manure and of chemical manures. Of course no farmer in his senses will allow the excrements of his stock, or any other refuse, animal or vegetable, produced on the farm to be wasted. But however carefully such manures are collected and returned to the soil, we must recollect that a large proportion of the farm-produce—*e.g.*, grain, milk, cheese, &c.,—is not consumed on the spot, but sold away. Now unless all the excreta of the persons, &c., eating such produce (or those of a similar number) could be likewise brought back to the farm, the soil must ultimately deteriorate, without the aid of chemical manures. Careful cultivation, drainage, subsoiling, &c., will, of course, delay the appearance of sterility, and may, for a certain time, even cause the soil to improve. But unless we are prepared to admit that vegetables and animals can create within themselves matter which they do not derive from their food, we cannot consider that "home-made manures" can permanently maintain the fertility of a plot of land under regular cropping. Of course if a farm is dressed with rotted leaves from a neighbouring forest, or with the ashes of wood brought from a distance, the deterioration of the soil may be delayed or prevented. But this is only robbing one plot of land for the benefit of another,—an evil which in fact underlies the use of bone manures, animal charcoal, blood manure, and the like.

We learn with surprise that in the mild climate of Florida "it is esteemed lucky if cattle and sheep survive the winter."

It is reported that in 1874 3,100,000 lbs. of buffalo-bones were forwarded on the Kansas and Pacific Railway.

Sixth Annual Report of the State Board of Health of Massachusetts. January, 1875. Boston: Wright and Potter.

We have here another valuable collection of results bearing upon sanitary science. We quote the following noteworthy passages:—

"The most recent experiments tend to show that we have been vastly overrating the oxidising and disinfecting properties of air, water, and earth.

"As to the final disposal of sewage, it is not yet possible to say definitely which one of the many plans now suggested and tried in different parts of the world will become generally adopted as possessing the least number of disadvantages, and the question must often be decided with reference to purely local considerations."

The slaughtering of cattle and swine appears to be the source of much nuisance in Boston, where 750,000 of the latter animals are annually killed within two miles of the State house. On this subject the report contains the following remarks, which will be found applicable to many nuisances of other kinds:—"The odours, generally speaking, were shown to be distinguishable, if taken singly, although their combination in many cases rendered it impossible to trace the offence of a given time to its proper source. They were shown, too, to be diffused to some degree in all directions, whatever the barometric pressure of the atmosphere, or the direction of the prevalent wind if not blowing violently. When the winds were light and variable, forming currents and counter currents of air, the noxious odours were as capricious as the winds themselves, and by the use of high chimneys they were sometimes offensive at a distance when scarcely perceptible at their source. They also existed at times in sharply defined strata, so as to be nauseating at one part of a house and not disagreeable in another." The so-called "soup," or liquor from rendering establishments, still escapes into the waters of Boston to the extent of many tons daily.

Dr. Adams, of Pittsfield, has contributed a paper on the "Comparative Advantages of Burial and Cremation." He holds "that there exists no necessity, on sanitary or economic grounds, for any change at present in our manner of disposing of the dead."

The bibliography of the subject is given at great length, and will prove very useful to all desirous of studying this question. The papers on the "Ventilation of Railway Carriages," and on the "Meat Supply in Reference to Public Health," are also very valuable.

Chemical Examination of Alcoholic Liquors. By Albert B. Prescott, M.D. New York: D. Van Nostrand.

The author gives, in a terse, compact form, a great amount of information on alcoholic beverages, their normal constituents, their impurities, and the intentional sophistications to which they are liable. Thus under whisky we read that "it is sometimes directed to add one or two drops each of creosote and purified fusel oil to the gallon!" "There is no evidence that strychnia has ever been used in the making up of whisky or other distilled liquor."

"Absinthe," we are told, "is a liqueur with 40 to 60 per cent by volume of alcohol and several per cent of volatile oils—those of wormwood, cinnamon, cloves, anise, and angelica being chiefly used. It has been coloured with acetate of copper, also with a mixture of indigo and gamboge." Acetate of copper and gamboge are not desirable for ingestion; but we doubt whether they can greatly add to the deleterious properties of absinthe.

On factitious wines, Dr. Prescott remarks very justly, "The artificial production of wines is not, like that of brandy, a task which chemical skill can hope to accom-

plish. Besides the great complexity of the ethers, the solid 'extractives' are requisite. Then the peculiarity—in many cases the commercial value—of an actual wine depends upon certain proportions of the constituents named above, which proportions the chemist cannot fully determine. The ethers of wine elude quantitative analysis. Moreover, there are doubtless substances in wine not identified. It may be perfectly true that a mixture of pure alcohol, water, glucose, bitartrate, and ethers may be made in such carefully-adjusted proportions that it will probably be capable of producing whatever effect wine would produce upon the system; and, indeed, may be less objectionable for administration, more agreeable, and (when offered as wine) more saleable, than are many grades of actual wine; yet such a mixture is not actual wine, and should not be presented as such."

The distinction between sedimentary and surface fermentation is briefly but clearly explained. A report is mentioned that at present colchicum seeds are used in Germany as a substitute for hops—a most reprehensible fraud. The presence of strychnia in beer is declared "improbable." "The drinking at one sitting of one to two pints of beer rendered 'suitably bitter' by strychnia would, according to Hassall's data, in most cases bring the beverage under immediate legal investigation." Dr. Prescott holds, however, "that there is no physical difficulty in its being held in solution in beer." It has been declared that strychnia would be precipitated by the tannin of the hop. But this constituent does not remain in beer. "Moreover, the insolubility of tannate of strychnia in 20,000 parts of water is by no means assured, and with the solvent action of acetic acid, as in beer, is quite improbable."

For the processes given for determining the constituents of fermented and distilled liquors, we must refer our readers to the work itself, remarking that this little volume will prove highly useful to the public analysts.

CORRESPONDENCE.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—The recent mineralogical correspondence in your journal has given rise to a good deal of reflection. I have re-perused the whole of it, and have been thinking as follows:—

How comes it that so many palpable errors have crept into the science of Mineralogy?

How is it that much ready assent has been given to that which is not truth?

Can it have been through want of proofs of things that are not extant? Or, of things that are extant, but have not yet been acquired, through lack of diligent search, as to their whereabouts?

It cannot possibly be through want of *skill* to use proofs in possession.

Can it be any lack of *will* to use proofs at command, through jaundiced prejudices of education or of anything else equally barbarous? One can hardly think so.

Or, has *probability* been intruding without proper introduction, so that doubtful or false propositions have been quietly allowed to usurp the place of right principles? Partly so, it may be.

Can it be that received hypotheses have been thoughtlessly relied upon as infallible conclusions? As likely as not. Or, have students (most of them) all along the line been blindly submitting to what is called *authority?*—a term, by the way, of exceeding delicacy; the submission to which, as a rule, implies a sort of *lazy* assent to received opinions upon certain matters *that* have never yet been fully investigated.

If this be the case, and it must be confessed that it looks very like it, the axe may as well be vigorously applied to the root of the tree of evil at once; for it has kept many of us in ignorance and incapacity quite long enough.

True loyalty means submission to *reasonable* authority; and that which is truth ought to be able to stand all sorts of testing without wincing.

My observations on the 3rd inst. touching certain minerals promptly brought me from two respectable sources the particulars I desired. A strong proof (if I required one) that there is no lack of the true Freemason spirit current amongst those who are lovingly addicted to mineralogical pursuits, and that it only wants a very little canal-cutting for it to flow in. Alas! but what must I say?

The chemical formulæ sent me *are not identical!* By no means a novelty; but this "trifling" fact induces me to remark again that if we had a mineralogical society, all new authenticated facts might find a sanctum in its records, and with obvious advantages.

Strange to tell, mineralogy has for a long time been most unrighteously pooh-poohed by many who ought to have known better. They did know better then. They know better now. They are beginning to allow that the neglected science holds rank of importance. Small condescension this considering its respectability; for it has nothing *mean* about it, and it is both captivating and elevating. Moreover, it has fewer jealousies and thwarting interests surrounding it than several of the natural sciences that might be mentioned. It does not at all clash with what are called the older sciences. It does the reverse of this. It claims the very closest relationship with several of the more prominent sciences. It is the intimate of everything and the friend of everybody. Its study has the singular merit of recommending itself. "In its shallows a child can wade, and in its depths a giant may swim." In fact, it is a deliciously delightful story that is without an end.

Mineralogy wants, in the first place, all the rubbish taken out of its nomenclature, and then to make a fresh start.

Everybody knows who David Page is. Hear what David Page says:—

"As yet the science of mineralogy, notwithstanding the sound progress which has been made of recent years, is in a very unsatisfactory state—cumbered by synonyms, overloaded with sub-divisions into so-called '*species*,'; and devoid of that unity of nomenclature which makes the terms employed express a portion of the information attempted to be conveyed."

It is sad to be obliged to acknowledge that mineralogy is not at present an exact science.

Medicine was not an exact science once. But as recently as 1868 the medical profession established a new society for the purpose of enquiring into the action of drugs! Rather late in the day some may say.

The inaugural address was given by no less a personage than *Sir Thomas Watson, Bart., M.D.*

In it he said, in courageous, simple honesty:—

"We know tolerable well *what* it is that we have to deal with; but we do not know *how* to deal with it." We want to learn distinctly what is the action of drugs and of other outward influences upon the bodily organs and functions. To me it has been a life-long wonder, how vaguely, how ignorantly, how rashly drugs are prescribed. We try this, and not succeeding, we try that; and, baffled again, we try something else: and it is fortunate if we do no harm in these our tryings. Now, this random and haphazard practice, wherever and by whomsoever adopted, is both dangerous in itself and discreditable to Medicine as a science. Our profession is continually fluctuating on a sea of doubt about questions of the gravest importance." (See *Lancet*, Jan. 18, 1868.)

I may be told that the cases are not parallel; perhaps they are not exactly? but permit me very earnestly to ask whether the mineralogists of this day profess less

moral courage than the physicians of that day? I do not think so. They possess at least as much, and that will suffice for the purpose. We want a new society to do away with the random and haphazard practice wherever and by whomsoever adopted, which has been so long inimicable to everybody's convenience and comfort.—I am, &c.

T. A. Readwin.

Liverpool, Sept. 10, 1875.

MINERALOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND.

To the Editor of the Chemical News.

Sir,—Mr. Readwin objects to the *limitation* of the title of the new society, and wants it to be *cosmopolitan*. I sincerely hope it may become so, but in the meantime would remind him of its *breadth*.

I do not happen to have here the full titles of all the societies he refers to, but the *Geological Society of London* is the full title of one of them, and certainly the proposed title is larger than this.

The Geological Society of London is supplemented by other Geological Societies—in Cornwall, Manchester, Liverpool, Yorkshire, Glasgow, Edinburgh, Dublin, and elsewhere. All these localised societies are doing good work, and I think it would be a great misfortune for them to be amalgamated with the Geological Society of London. The case is, however, different with Mineralogy, as mineralogists are much less numerous than geologists, so that it occurred to me that all local work might be brought into a common focus by arranging local meetings of sections appointing their own local Secretaries, wherever a few working mineralogists could be got together.

Mr. Readwin truly remarks that "British and Irish mineralogists have intelligent friends all over the world," and it is hoped that these will become *corresponding members*. However, all such matters of detail as title, rules, &c., will be best settled by the votes of the first fifty members, and I trust this number will be completed in a very short time.—I am, &c.,

J. H. Collins.

Truro, September 18, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 7, August 16, 1875.

Ninth Note on the Electric Conductibility of Bodies Moderately Conductive; Electric Polarisation of Minerals.—M. Th. du Moncel.—In two memoirs presented to the Academy on October 5 and 26, 1874, the author called attention to the fact that electric conductibility through mineral matters is most frequently accompanied with very energetic effects of polarisation, the result of which is sometimes to weaken successively, and in enormous proportions, the electric current which traverses them; sometimes to augment it by degrees, sometimes to weaken it at first and increase it subsequently. He attributed at first these effects to local actions developed in the interior of the stones under the influence of the current which traverses them, which actions combining with the effects of polarisation may, up to a certain point, explain the effects observed. But what is the nature of these local actions? This remained to be explained, and the author caused a certain number of specimens of stones of different kinds to be cut with much care in order to study them under this especial point of view. One of these specimens, remarkable on account of the effects which it presents, has thrown a very distinct light on this matter, and brought to day certain novel and very interesting phenomena. It is a grey quartz, found in the limestone quarries of Héronville, near Caen. The author has had cut from this stone a small prism, 38 m.m. in length, 24 in width, and 5 in thickness. It has been polished on two sides, and it has only been experimented upon after having been kept for seven months in a very dry place. In spite of its dryness, the conductibility of this stone was so great that to determine the variations of the current which traversed it he was obliged to connect the ends of the wire of his galvanometer, of 36,000 spiral folds, by a derivation of 4 kilometres of resistance. The effects produced by the stone in question were quite peculiar, both as regards the strength and the duration of the current of polarisation. It appears that effects of polarisation exist in most minerals, and that these effects may even sometimes give rise to secondary currents relatively intense. If the electric conductivity across stones was merely the result of an electrolytic conductivity occasioned in the midst of a moist conductor, these effects might be explained by the intervention of local pre-existing couples. But with stones so hard and dry it is difficult to admit the presence of this moist conductor, and we are naturally led to refer the polarisation in question to the electrification of the bodies in the electrotonic way, and under the influence of effects of condensation.

Reducing Action of Hydriodic Acid at Low Temperatures upon the Ethers, properly so-called, and the Mixed Ethers.—M. R. D. Silva.—From his experiments the author considers himself enabled to deduce the following propositions:—1. When hydriodic acid gas reacts upon an ether, properly so-called, between zero and +4°, the hydrogen of one molecule of gas and one of the hydrocarbon groups of a molecule of ether are exchanged in the two molecules, the result being an alcohol and the corresponding ether. 2. When the hydriodic gas reacts upon a mixed ether, between 0° and +4°, the hydrogen of one molecule of the gas, and the hydrocarbon group less rich in carbon of one molecule of ether, are interchanged in the two molecules. There is formed the alcohol corresponding to the hydrocarbon group more rich in carbon, and the iodide of the alcohol corresponding to the hydrocarbon group less rich in carbon. 3. All the mixed ethers, of which one of the monatomic hydrocarbon groups is methyl, are transformed under the influence of hydriodic gas between 0° and +4° into iodide of methyl and an alcohol corresponding to the other hydrocarbon group of the ether.

Synthetic Researches on the Uric Group.—M. E. Grimaux.—The author on a former occasion (*Comptes Rendus*, lxxxi., No. 7, 1875) made known certain ureic derivatives from asparagin, namely, malylureic amide and malylureic acid, and indicated the formation of three new bodies obtained by the action of bromine upon this acid in presence of water. In pursuing these researches two new bodies have been discovered on studying the action of dry bromine upon malylureic acid.

Analysis of the Gases Evolved in the Island of Saint Paul.—M. Ch. Velain.—The gas disengaged on the north of the landing-place, where abundant and continuous fumeroles are found on the shore, has a temperature of 78° to 80°, and the following composition:—

Carbonic acid	14·24
Oxygen	17·01
Nitrogen	68·75
	100·00

Fourth Note on Processes of Magnetisation.—J. M. Gaugain.—The process of magnetisation known as double touch may be analysed in the same manner as that of single touch.

Researches on Tempered Glass.—V. de Luynes and Ch. Feil.—The fracture of blocks and plates of tempered

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glass, varying in form and size, presents an analogy to that of Prince Rupert's drops, both in the circumstances under which it is produced, and in the form and arrangement of the fragments derived from the rupture of the glass. In general, it is not possible to cut a piece of tempered glass with the saw, the drill, or the file without its bursting into shivers. In some cases, however, the operation is practicable. Thus a disc may be pierced at its centre without bursting, but it breaks up if perforated in any other point, or if sawn along a diameter. A square plate of glass of St. Gobain, when tempered, shows on examination with the aid of polarised light a black cross, the limbs of which are parallel to the sides of the square. In these directions the plate may be cut without bursting. But without these lines, whether parallel or transversely to their direction, it cannot be cut or pierced without a rupture.

Certain Double Metallic Sulpho-Carbonates.—M. A. Mermet.—The author has obtained well defined crystals by combining the alkaline sulpho-carbonates with those of the heavy metals. He has isolated the crystals of the double sulpho-carbonate of potassium and nickel.

Reagent Proper for Detecting the Sulpho-Carbonates in Solution.—M. A. Mermet.—A recent and dilute solution of the nickelate of ammonia is recommended. Pour into a test-tube a few drops of solution of nickel sulphate or chloride; add excess of ammonia and water until the mixture, on agitation, becomes colourless. A few drops of the solution of the sample in question are then added. If even a trace of sulpho-carbonate is present, a gooseberry-red is obtained. Alkaline monosulphides give a brown or black shade.

No. 8, August 23, 1875.

Compound of Platinum, Tin, and Oxygen analogous to the Purple of Cassius (Platino-Stannic Oxide of M. Dumas).—MM. B. Delachanal and A. Mermet.—It is stated in treatises on chemical analysis that if we mix solutions of bichloride of platinum and protochloride of tin a brown tint appears, but no precipitate. This statement is correct; but if the solution is diluted with much water, and boiled, a brown substance separates out, which, after being washed for a long time with hot water, no longer contains chlorine, but merely oxygen, platinum, and tin. This interesting compound is, like the purple of Cassius, a hydrate, and shows, like the same compound, a composition varying according to the circumstances under which it has been produced. It has been obtained, not merely by the process mentioned above, but by placing a sheet of tin in a solution of bichloride of platinum: the liquid takes a dark colour, and a precipitate is formed, which increases much if the liquid is diluted with water and boiled. This procedure, as is well known, yields under analogous conditions the purple of gold. The substance which the authors describe dissolves in vitreous fluxes, giving them a greyish tint. At 100° it loses water, and if calcined it experiences a further loss of weight, which should correspond to an escape of oxygen. Under the microscope it appears in the form of amorphous granules, translucid and yellowish. Boiling alkalies and aqua regia attack it; alkaline carbonates at the heat of fusion form a stannate and platinum in a state of division. The product obtained by mixing the two solutions of platinum and tin was found to consist of—

Oxygen	28·51
Tin..	60·00
Platinum	11·49

That prepared by immersing metallic tin in the bichloride of platinum gave, when dried at 160° C.,—

Oxygen	27·31
Tin..	55·50
Platinum	17·19
	100·00

Oil of Bankoul.—M. E. Heckel.—The author dissents from certain views put forward by M. Corenwinder in his paper of June 28th. He maintains that the oil of bankoul is little more purgative than that of sweet almonds. He states that the oil was used in New Caledonia for the lamps in a lighthouse, but that it corroded the metal jets, even those of platinum. M. Heckel was requested by the local government to undertake its purification, but did not succeed.

Gazzetta Chimica Italiana, Anno v., 1875, Fasc. vi.

Defence of the Old Theory of Electrostatical Induction.—G. Pisati.—Not adapted for abstraction.

Chemical Decomposition: Dissociation applied to the Interpretation of certain Volcanic Phenomena; Synthesis and Analysis of a New Mineral from Etna, and of Common Origin in Volcanos.—O. Silvestri.—The author, on passing perfectly dry ammoniacal gas through a red-hot platinum tube, obtained at the other end a gas having all the characters of nitrogen mixed with a trace of hydrogen. The ammonia had been dissociated by the heat, and the hydrogen had passed through the pores of the tube. On repeating the experiment in a platinum tube filled with coarse fragments of recent lava from Etna, a small quantity of hydrogen escaped at the other extremity, the nitrogen having become fixed in the lava, and the greater part of the hydrogen having escaped as before. Iron heated, in contact with ammoniacal gas, increases in weight by 6 per cent. The fixation of the nitrogen is due to the formation of a nitride of iron, specimens of which were obtained after the recent eruption of Etna, and found to consist of—

Iron	90·859
Nitrogen	9·141
	100·000

Peroxide of Iron as a Generator of Nitric Acid, and on the Origin of Nitre in some Experiments of Cloëz.—Dr. Leone Pesci.—The author's results are: that sesquioxide of iron is capable of nitrifying ammonia; that, as Prof. Selmi holds, the first step in nitrification is probably the formation of nitrous acid; that this oxidation is effected by the sesquioxide of iron, not as a porous body, condensing oxygen from the air, but giving up oxygen of its own as proved by its reduction out of contact with the air; if exposed to the air the sesquioxide is not reduced since the oxygen withdrawn is replaced from the atmosphere. This explains the fertilising action of compounds containing peroxide of iron. Hence also ochraceous limes are preferable for artificial nitre-beds. Lastly, in the experiment of Cloëz, ammonia was evolved, to the oxidation of which rather than to the direct oxidation of atmospheric nitrogen must be ascribed the formation of nitric acid.

Oleandrine and so-called Pseudocurarin.—Dr. Ciro Bettelli.—Cattle having been poisoned by eating oleander-leaves, the author made an investigation of oleandrin and pseudocurarin, two poisonous principles present. Oleandrin with concentrated sulphuric acid gives a splendid orange colour, which on the application of heat passes into a violet-red. With sulphuric acid and bichromate of potash it gives first an orange, then a yellowish green, and finally an emerald green, which remains for some time. With sulphuric acid and ceric oxide it gives an orange which passes into violet.

Concurrence of Albumen in Rendering Tricalcic Phosphate Soluble in the Blood.—M. Mercadante.—The author concludes that the solubility of phosphate o lime in the blood results not from the presence of one substance, but is the result of a mixture of bodies.

Presence of Leucin in Tares.—A. Cossa.—The author finds that leucin is a constant ingredient in tares grown in the dark.

Bulletin de la Societe Chimique de Paris,
Nos. 4 and 5, September 5, 1875.

Researches on the Constitution of the Albumenoid Bodies.—M. Schutzenberger.—Seeing the almost complete identity of the numbers found in the elementary analysis of the amidated mixtures furnished by the principal albumenoid bodies, and leaving on one side vegetable fibrin which offers certain peculiarities requiring further investigation, we may admit as extremely probable that these mixtures are similarly constituted, not merely qualitatively, but also quantitatively. We arrive thus at the conclusion that the albumenoid bodies have really a common nucleus, having an identical constitution in each case. The differences observed between the albumenoid bodies would then depend on the nature and proportion of the secondary principles grouped around this nucleus. This view resuscitates, under a more precise form, the old protein theory of Mulder, with this distinction—that we can now give an account of the constitution of the common nucleus. Ossein, gelatin, belongs evidently to another type, and the nucleus, though analogous, is not identical.

Combination of Methylic Oxide and Hydrochloric Acid.—M. C. Friedel.—Already noticed.

Table for the Transformation of Specific Gravities.—A. Theunis.—The table in question is not inserted.

Baryta Green.—To a mixture of 2 parts of caustic soda and 1 part chlorate of potash are very gradually added 2 parts of manganese in fine powder. The temperature is finally raised to incipient redness. The mass is then allowed to cool, powdered, and exhausted with water, and to the green filtrate is added a solution of nitrate of baryta. Manganate of baryta of a fine violet colour is deposited, and is washed with care. This substance when dry is treated with from ½ to 1 part of hydrated baryta, and heated gradually to incipient redness, with constant stirring. The mass when cold is of a fine green. It is then powdered and washed, to remove any excess of baryta.

M. Reimann's Farber Zeitung,
No. 32, 1875.

Refuse Waters from Cloth Manufactories.—The waters in question are derived from fulling and rinsing woollen cloths, and are estimated to contain the oil used in spinning, to the amount of 15 per cent of the weight of the wool, and the soap employed in fulling, which is 30 per cent of the weight of the cloth. The author recommends that these waters should be collected in appropriate tanks, precipitated with milk of lime, and that the lime soaps thus formed should be decomposed with sulphuric acid. The total waste for the whole of Europe is estimated at 2,125,000 cwts. of fatty matters.

Importance of Chalk in Madder Dyeing.—The writer points out that by the addition of chalk to a mixture of alizarin and purpurin, any desired tone may be produced, though with loss of the one or the other colouring matter. Hence it appears why the same sample of garancin, or fleur de garance, will produce a good red, with little chalk, or a good purple with much chalk. If a mixture of alizarin and purpurin is treated with an alkaline solution at 200° in a closed vessel, more alizarin is obtained than purpurin. In this manner the purity of a purpurin may be recognised, and pure alizarin can be obtained from the ordinary alizarin of commerce. The preparation of pincoffin depends on the destruction of the purpurin, which explains its low tinctorial power, and the fact that it is much better adapted for purples than for reds.

This issue further contains recipes for a finishing for mixed satins; a lead colour and a fast Bismarck brown, for wool; a brown, an orange, a ponceau, and a scarlet, for woollen printing; a deep blue on an indigo bottom, for cotton drills; and a light and dark rust yellow for cotton yarns.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 17, August 26, 1875.

This issue mentions the death of Prof. von Schroetter, Director of the Viennese Mint. As this distinguished chemist died April 15th, the announcement is somewhat late.

The Academy of Sciences of Vienna is occupied with the question of the decrease in the quantity of water in springs and rivers. During a certain number of years there has been a decrease in the waters of the Danube.

Revue Universelle des Mines, de la Metallurgie, de Travaux Publics, des Sciences et des Arts Appliques a l'Industrie, May and June, 1875.

On an Electrolytic Method applied to the Determination of Certain Metals, and on the Thermo-Electric Battery of Clamond.—Oscar Loiseau.—This valuable paper would be unintelligible without the accompanying illustrations.

MISCELLANEOUS.

Chemistry in Australia. — Mr. R. W. Emerson MacIvor, F.C.S., Assistant to the Professor of Scientific Chemistry at the Andersonian University, Glasgow, has been appointed Lecturer on Agricultural Chemistry to the districts of West Bourke and Ballyratt, Victoria, Australia.

Miners' Association of Cornwall and Devon.—In order to stimulate research, experiment, and invention, and to promote the advancement of mining enterprise in Cornwall and Devon, Mr. G. L. Basset, of Tehidy, offers a prize of £50 for the discovery of a new mineral, in Cornwall or Devon, which is deemed likely to become commercially valuable: an accurate analysis and a description of the leading physical properties and distinguishing characteristics of the mineral to be given, specimens to be handed to the Committee, and the locality and mode of occurrence to be distinctly described. For the invention of a method—mechanical or chemical—of making marketable, with commercial advantage, ores or minerals produced in Cornwall or Devon, and hitherto regarded as worthless or of little value, the method being clearly described, and specimens of the product in its several stages being handed to the Committee; or—For the discovery of some new application of a mineral substance already known to occur in Cornwall or Devon, either by itself or in combination, to some useful purpose, so as to render it of marketable value, or materially to enhance its value if already marketable to some extent, Mr. Basset offers a prize of £100. Communications may be addressed to Mr. J. H. Collins, F.G.S., 57, Lemon Street, Truro.

NOTES AND QUERIES.

Test for Free Acid in Coal-Gas.—Can your readers inform me, through the medium of your paper, whether there is any test for free acid that can be used in gas-light when it is impossible to distinguish the colour of litmus-paper?—W. S.

Commercial Phosphates.—You would, I believe, confer a very considerable favour on provincial chemists like myself, who were unable to attend the late meeting of the British Association, if you could find space in an early issue of the Chemical News for the Report of the Committee on Commercial Phosphates and Potass Salts.—Analyst.

[This Report is already in the printer's hands. The first part will appear in our next number.—*Ed. C. N.*]

Chrome-Iron Alloy.—(Reply to G. G. B.)—It is evident from article (Chem. News, vol. xxxii., p. 136) that the use of chromate of iron in the manufacture of speigeleisen is a mere experiment, and G. G. B. must wait some time before he will get much more information on the subject. Chrome-iron ore, FeO,Cr_2O_3, being composed of—

Oxide of chromium	69 per cent.
Oxide of iron	31 "
	100 "

is abundant in Nature, and exists in France, Norway, Silesia, Maryland, Pennsylvania, Baltimore, and St. Domingo. It has been found in Banffshire and Stirlingshire.—Dersunthal.

THE CHEMICAL NEWS.

Vol. XXXII. No. 827.

CHEMICAL AND SPECTROSCOPIC CHARACTERS OF A NEW METAL, GALLIUM, DISCOVERED IN THE BLENDE OF THE MINE OF PIERREFITTE, IN THE VALLEY OF ARGELES, PYRENEES.

By M. LECOQ DE BOISBAUDRAN.

Between three and four in the evening of August 27, 1875, I found indications of the probable existence of a new elementary body in the products of the chemical examination of a blende from the mine of Pierrefitte. The oxide, or perhaps a sub-salt, is thrown down by metallic zinc in a solution containing chlorides and sulphates. It does not appear to be the metal itself which is reduced by the zinc. The chloride is precipitated by a small quantity of ammonia. In a mixture containing an excess of zinc chloride, the new body is thrown down before the zinc if the liquid is treated with an insufficient quantity of ammonia. From the second precipitate the proportion becomes trifling, almost all the new body being found in the first fraction. Even in the conditions which should correspond to a state of peroxidation, the oxide is soluble in an excess of ammonia. Its salts are thrown down by sulph-hydrate of ammonia, an excess of which does not perceptibly re-dissolve the sulphide formed. The salts are also precipitated by sulph-hydrate of ammonia in presence of acetate of ammonia and of an excess of free acetic acid. In presence of zinc the new body is concentrated in the first sulphides deposited. Yet six successive precipitations are required to remove entirely the sulphide of zinc. The salts are not precipitated by hydrosulphuric acid in solutions slightly acidulated with hydrochloric acid. The oxide re-dissolves in an excess of carbonate of ammonia along with zinc. The extremely small quantity of the substance at my disposal did not permit me to isolate the new body from the excess of zinc accompanying. The few drops of zinc chloride in which I concentrated the new substance gave under the action of the electric spark a spectrum composed chiefly of a violet ray, narrow, readily visible, and situate at about 417 on the scale of wave-lengths. I perceived also a very faint ray at 404.

An additional note presented to the French Academy, contains the following details:—"The experiments executed since August 29, confirm me in the view that the body in question is a new element for which I propose the name Gallium. The sulphide is really insoluble in hydrosulphate of ammonia. I have obtained the chloride in such a state of concentration that the ray 417 is very brilliant under the action of the induction spark. The chloride gives the ray 417 in a gas flame, but more feebly. The salts are easily precipitated in the cold by carbonate of barium. In a mixture with a large excess of zinc chloride the new substance is thrown down by hydrosulphate of ammonia along with the first portions of zinc sulphide. Repeated evaporations with large excesses of *aqua regia* do not appear to occasion any loss from volatilisation of the chloride. The sulphide seems to be white, like that of zinc, a point to be decided after complete purification of the body. If hydrated zinc chloride containing traces of the new substance is heated to the point where a small quantity of oxychloride of zinc is formed, all the gallium remains in the insoluble state, probably as oxychloride. The spectrum is more brilliant with a spark of moderate length than with a very short spark.

REPORT ON THE METHODS EMPLOYED IN THE ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS, AND ON THE MODE OF STATING THE RESULTS.*

The Committee was of opinion that the objects for which it was appointed would be best attained by ascertaining as fully as possible the details of the methods of examining phosphates and potash salts in general use, and learning the opinions of the chemists employing them as to their special advantages and limits of error, at the same time collecting information on other closely related matters.

With the view of carrying out these intentions to the fullest possible extent, the Committee issued a circular-letter setting forth their aims and objects, and sent it to every member of the Chemical Society, to all gentlemen known to be interested in the subject, and to such chemists as your Committee learnt would be likely to afford assistance.

Together with the above circular-letter the Committee forwarded a series of very carefully arranged questions, with the view of indicating the exact nature of the information they were in need of.

No effort has been spared to make the objects of the Committee widely known, and nearly a thousand circulars have been distributed. In the case of chemists known to have special knowledge of the subjects on which information was desired, the circulars were accompanied by manuscript letters from the Secretary, requesting careful consideration of, and full replies to, the queries. In answer to their request for information, the Committee has received contributions from a considerable number of chemists, both in England and on the Continent, the answers in many cases containing much original information, and being generally of the utmost value in enabling the Committee to form an opinion on the present state of the questions which it was appointed to consider and report on. On receipt of the replies a further correspondence was in many cases entered into by the Secretary, with the view of obtaining explanation of, or further information upon, doubtful points, and every means has been taken to elicit the views of correspondents.

The following is an alphabetically-arranged list of chemists to whom the Committee is indebted for information:—

Berrand, Dr. G., Manager of the United Chemical Works of Leopoldshall.
Bloxam, C., Professor of Chemistry, King's College, London.
Blunt, T. P., County Analyst for Shropshire, &c.; Chemist to the Shropshire Chamber of Agriculture.
Brown, Campbell, D.Sc., Lecturer on Chemistry at the Liverpool Infirmary School of Medicine; Public Analyst for Liverpool.
Burnard, C. J., senior partner of the firm of Burnard, Slack and Alger.
Cameron, C. A., M.D., Professor of Chemistry Royal College of Surgeons Ireland; Analyst to Royal Agricultural Society of Ireland, City of Dublin, &c.
Cammack, J., Analyst to Bridgwater Chemical Works, St. Helens.
Church, A. H., M.A. Oxon., Professor of Chemistry R. A. College, Cirencester.
Cowan, W. M., Public Analyst for Greenock.
Cox, J.. late Chemist to Nottingham Mills Manure Co.
Cruse, V., Chemist to Messrs. E. Packard and Co., Ipswich.
Fairley, T., Consulting Chemist to Yorks Agricultura Society; Public Analyst for Leeds.

* Presented to the British Association, Bristol meeting. Report of a Committee of Section B, consisting of E. C. C. Stanford, Chairman James Dewar; Alfred E. Fletcher; and Alfred H. Allen, Hon. Secretary.

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Flight, W., D.Sc., Assistant Examiner in Chemistry, London University.
Franz, W., Chief Manager of the United Leopoldshall Works, Wiesbaden.
Fresenius, C. R., Author of "Handbook of Chemical Analysis."
Galbraith, W., late Chemist to Phospho-Guano Co., Liverpool.
Hamlet, W. A., Analyst to Peruvian Government Guano Co. Agency.
Hughes, J., Lawes Chemical Manure Co., Deptford and Barking.
Joulie, H., Paris.
Kitchen, A., Whitehaven.
Lansdell, M. J., of Messrs. J. C. Nesbit, Lansdell, and Co., London.
Leisler, Bock, and Co., Glasgow.
Lichtenstein, M., London.
Lupton, S., The Harehills, near Leeds.
Newton, Keates, and Co., St. Helens.
Ogilvie, T. R., late Public Analyst for Greenock.
Parnell, E. W., Desoto Alkali Works, Widnes.
Prentice, M., jun., Stowmarket.
Pattinson, J., Public Analyst, Newcastle-on-Tyne.
Reddrop, T., Chemist at L. and N. W. R. Company's Works, Crewe.
Rosenthal, Dr. G., Chemist to Messrs. Holloway Bros.
Ruffle, J., late Assistant to Dr. Voelcker and to Dr. F. C. Calvert.
Sibson, A., Analytical Chemist, London.
Ulex, Dr. G. L., Hamburg.
Wallace, Tatlock, and Clark, Joint Public Analysts for the City of Glasgow.
Warington, R., formerly Chemist to J. B. Lawes and Co.
Williams, W. J., Chemist in charge of Phosphate Sewage Company's Works at Hertford.

It will be observed that in almost every case the replies have been from chemists having special experience in the analysis of commercial phosphates or potash salts, and their communications contain in the aggregate an amount of information on the subject probably far in excess of any previously collected.

With a few notable exceptions, the Committee has received assistance from all the best known authorities on the subject: a few of the leading chemists, known to have special experience of the kind required, have not responded to the Committee's request for information, though their assistance was most courteously sought by a special letter in each case.

The cause of the silence observed in the above-mentioned cases is probably similar to that which prompted the following reply from a well known firm of chemists, whose results were in some degree the cause of the appointment of the Committee.

"June 19, 1875.

"Mr. Alfred H. Allen.

"Dear Sir,—We are in receipt of your favour relating to the examination of phosphates and potash salts, but we must decline to give you the information required, as we do not think ourselves called upon to publish our methods of analysis, which we have perfected after long and careful investigation, for the benefit of those who have not taken this trouble.—We are, dear Sir,

"Yours obediently, &c."

A French chemist of very high standing says he belongs to a class of chemists who cannot afford to work "*pour la gloire*," but must keep their methods—their only capital—secret.

It is evident that the interests of science would materially suffer if a similar system were adopted by many chemists; but happily the above answers stand in striking contrast to the generous and elaborate replies that have in many instances been sent to the Committee.

The answers received to the various specific questions put have shown, in a very striking manner, how very varying, and even irreconcilable, are the opinions held by chemists on many of the points submitted for their consideration. On this account the Committee refrains for the present from expressing any definite opinions on the points in question; but, feeling that the communications received contain much information which should be at once in the possession of those interested, it begs leave to submit to the Association the following digest of the replies received up to the present time. The Committee has avoided, as far as possible, any specific mention of the sources of the various items of information, but has departed from this rule in cases in which the value of the information would have been seriously diminished if the authority on which it was quoted had not been given.

(To be continued.)

NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY IN THE LABORATORY OF THE UNIVERSITY OF VIRGINIA.

No. IV.

Communicated by J. W. MALLET,
Professor of General and Applied Chemistry in the University.

(1). *Analyses of Native Wines of Virginia.* By R. M' Cooper, of Mayesville, South Carolina.

The cultivation of the grape has assumed considerable importance in Virginia within the last few years, the fresh fruit being sent in large quantities to the markets of the larger cities further north, and the production of wine having also grown up at a rapidly increasing rate. In the absence of any analyses of these native wines, I proposed several months ago to have some specimens examined in this laboratory, with a view to fixing to some extent the character of the wine at present made, and in the hope of furnishing some information which may be useful in the improvement of the manufacture. I wrote to several persons engaged in this industry asking for samples of their products, and received in response the following, which were analysed by Mr. Cooper:—

(1). "Virginia claret."—A red wine, made from the juice of the "Alvey" grape, with no addition of spirit or sugar. From the Monticello Wine Company, of Charlottesville, Albemarle Co., Va.; Ad. Russow, superintendent.

(2). "Virginia hock."—White wine, made from first pressing of "Concord grapes," with no addition of sugar; vintage of 1873. From Monticello Wine Company.

(3). "Bacchantees."—Light red wine, made from pure juice of "Concord" grape; vintage of 1871. From the Laurel Hill Vineyard, Norfolk County, Va.; T. W. Lemosy, proprietor.

(4). "Concord" (or "claret").—A red wine of medium depth of tint, made from "Concord" grape. From the Belmont Vineyard, Front Royal, Warren Co., Va.; M. B. Buck, proprietor.

(5). "Sweet Concord."—Dark red wine, made from "Concord" grape, with the addition of some refined cane sugar syrup; vintage of 1871. From Laurel Hill Vineyard.

(6). "Ives" (or "claret").—Wine of fine, clear, red colour, made from pure juice of "Ives" grape. From Belmont Vineyard.

(7). "Delaware."—Very pale, bright, white wine, made from juice of "Delaware" grape, with addition of ½ lb. of sugar to each gallon of must; vintage of 1873. From Monticello Wine Company.

(8). "Sweet Delaware."—White wine, made from "Delaware" grape, with addition of refined syrup; vintage of 1871. From Laurel Hill Vineyard.

(9). "Delaware" (or "hock").—Very bright white wine, made from pure juice of "Delaware" grape. From Belmont Vineyard.

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(10). "Catawba" (or "hock").—White wine, made from pure juice of "Catawba" grape. From Belmont Vineyard.

(11). "Norton's."—Very dark purple-red wine, made from "Norton's Virginia" grape (said to be an indigenous seedling), with no addition of sugar or spirit; vintage of 1873. From Monticello Wine Company.

(12). "Dry Norton's Virginia."—Deep red wine, said to have been made from pure juice of "Norton's Virginia" grape, with no addition to must. From Laurel Hill Vineyard.

As regards the method pursued in the analyses,—

The alcohol was determined by careful distillation after dilution with water, neutralisation with sodium hydrate, and addition of a little tannic acid to prevent foaming; the specific gravity of the distillate and its absolute weight being finally taken.

For the volatile acids, the wine was neutralised with sodium hydrate, alcohol distilled off, excess of phosphoric acid added, and the distillation repeated, the second distillate being then neutralised with standard lime-water, with rosolic acid as the indicator.

The total acid was determined by dilution and neutralisation with standard solution of base, both lime-water and ammonia being used, with hæmatoxylin and rosolic acid, respectively, as indicators.

Non-volatile acid was found as the difference between the volatile and total acid.

Glucose was determined by means of Fehling's copper solution. Unaltered cane sugar was tested for, but in no instance found.

Tannic acid was estimated by the method of Maumené, viz., addition to wine of a little alcohol, then excess of baryta-water and a little ammonium chloride, warming gently, filtration, washing of precipitate with alcohol, followed by water, solution of precipitate in dilute sulphuric acid, and titration with indigo-carmine and potassium permanganate.

The total dry residue was obtained by cautious evaporation and drying at 110° C.

A separate portion of wine was evaporated to dryness, with addition of a little barium sulphate to enable the residue to be removed from the vessel, and nitrogen determined by combustion with S. W. Johnson's mixture of sodium carbonate and calcium hydrate.

The former portion of dry residue was burnt at as low a temperature as possible, and the ash weighed.

Potassium, present in the ash mainly as carbonate, was determined as platino-chloride.

The following were the results obtained, expressed in percentage, by weight:—

Detailed information as to the history of each specimen of wine was asked for, including the natural conditions of growth, method of culture, precise steps of manufacture, &c., but the replies were too incomplete to furnish satisfactory data for fully criticising the above results. On the whole, it would seem that two points chiefly deserve attention:—

(1). The rather irregular alcoholic strength of wine made from the same grape appears to indicate that due attention is not yet given to the full ripening of the fruit and its careful selection in gathering, ripe and unripe and partially decayed grapes being to too great an extent mixed together in the vat.

(2). The total amount of acid is pretty high, though not excessively so, and, in some instances at least, too large a proportion of this consists of the volatile acids, whose presence in large amount is suggestive of commencing unsoundness.

These wines are all comparatively new, and, in view of the somewhat considerable amount of nitrogenous matter present, greater care seems to be needed in the after stages of fermentation and clearing, involving the use of perfectly clean vessels, exclusion of air, &c.

The statements of the producers as to use or exclusion of sugar added in the manufacture are fully borne out, except in the case of No. 12, in which, notwithstanding the fact that "Norton's Virginia" is naturally a somewhat heavy wine, the proportion of unfermented sugar is too large. As, however, the maker admittedly produces both pure and sweetened wine from the same grape, it is not unlikely that a sample of the one may have been accidentally sent instead of the other.

A comparison of the figures in the above table with one another, as regards several of the constituents—as, for instance, the ash and its contained potash—developes points of local interest, both in reference to the same grape at different places and different grapes produced at the same place.

There is no reason to doubt that grape culture in this State, already successful as regards the sale of the fresh fruit, offers much also of promise for the future in reference to the production with adequate care of sound, wholesome, and palatable wines.

(2). *Examination of amount of Bismuth present in various specimens of so-called Sub-Nitrate of Bismuth employed in Medicine.* By W. R. Nelson, jun., of Charlottesville, Va.

Some time ago I noticed the rather odd fact that "sub-nitrate of bismuth" for medical use, when of French manufacture, was sold here at a higher price than American,

No.	Name and Source of Wine.	Specific Gravity at 15·5° C.	Absolute Alcohol, by weight.	Volatile Acid, calculated as Acetic Acid.	Non-Volatile Acid, calculated as Tartaric Acid.	Total Acidity, calculated as Tartaric Acid.	Sugar (Glucose).	Tannic Acid.	Solid Residue dried at 110° C.	Nitrogen.	Albumenoid Matter, calculated from Nitrogen.	Ash.	Potassium, calculated as Carbonate.
1.	Virginia claret—Alvey grape—Monticello Co.	0·9949	9·80	0·15	0·60	0·79	0·070	0·018	1·78	0·013	0·083	0·24	0·148
2.	Virginia hock—Concord grape—Monticello Co.	0·9932	8·56	0·07	0·43	0·53	0·058	0·004	1·84	0·019	0·122	0·17	0·111
3.	Bacchantees—Concord grape—Laurel Hill	0·9941	10·04	0·15	0·35	0·54	0·047	0·019	1·52	0·013	0·083	0·14	0·098
4.	Concord—Concord grape—Belmont	0·9926	10·03	0·13	0·44	0·61	0·045	0·011	1·60	0·006	0·038	0·15	0·098
5.	Sweet Concord—Concord grape—Laurel Hill	1·0050	11·79	0·39	0·17	0·66	3·152	0·006	5·11	0·006	0·038	0·13	0·111
6.	Ives—Ives grape—Belmont	0·9913	11·13	0·12	0·57	0·73	0·065	0·009	1·69	0·008	0·051	0·12	0·074
7.	Delaware—Delaware grape—Monticello Co.	0·9931	9·46	0·10	0·41	0·55	0·075	0·008	1·98	0·014	0·090	0·24	0·160
8.	Sweet Delaware—Delaware grape—Laurel Hill	1·0117	10·57	0·56	0·01	0·72	3·703	0·006	6·41	0·009	0·058	0·17	0·111
9.	Delaware—Delaware grape—Belmont	0·9875	12·69	0·08	0·41	0·52	0·106	0·002	1·42	0·016	0·102	0·12	0·086
10.	Catawba—Catawba grape—Belmont	0·9902	10·04	0·16	0·42	0·63	0·031	0·003	1·41	0·012	0·077	0·13	0·086
11.	Norton's—Norton's Virginia grape—Monticello Co.	0·9953	10·57	0·22	0·48	0·76	0·112	0·019	2·66	0·018	0·115	0·31	0·234
12.	Dry Norton's Virginia—Norton's Virginia grape—Laurel Hill	0·9981	11·79	0·41	0·50	1·02	1·228	0·011	3·55	0·016	0·102	0·20	0·148

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on the assumed ground of greater purity, while, on testing the two, I found the French preparation to be, in reality, not basic nitrate at all, but oxychloride, the American being what it professed to be.

Mr. Nelson undertook to determine the proportion of bismuth present in some specimens of material from the two sources named. The following are his results, two of the determinations being by another hand:—

Manufactured or Sold by—		Bismuth. Per cent.	Chlorine. Per cent.
Dorvault and Co., Paris	In drops.	75·28	6·19
E. Rousseau, Paris ..	„	75·39	5·74
Lazell, Marsh, and Gardiner, New York ..	In powder.	72·84	traces
	In drops.	71·06	
Rosengarten and Son, Philadelphia	In powder.	72·46	

The French preparations were found to contain a little basic nitrate, but so little that the diminished percentage of bismuth, as compared with the pure oxychloride, which requires—

(For BiClO) { Bismuth .. .. 80·31 per cent,
Chlorine .. .. 13·57 „

may be considered as essentially due to water retained. On the other hand, the much greater deficiency of chlorine as compared with the requirement of the formula is, doubtless, caused by the practice of saving bismuth by the addition of alkali to the water used for precipitation, leading to the presence of hydrate. The use of water of ammonia for this purpose is prescribed by the present United States pharmacopœia, and to this is partly due the fact that in the American preparations we find the percentage of bismuth intermediate between that of the normal basic nitrate—

$Bi(HO)_2(NO_3)$ .. .. 68·62 per cent.

and of the hydrate—

$Bi(HO)O$ .. .. .. 86·42 „

(3). *Analysis of Crystallised Ammonium Oxalate from Guanapi Guano.* By Dr. J. A. Tanner, jun., of Lynchburg, Va.

There is some little confusion observable in the published statements as to the occurrence of ammonium oxalate in Peruvian guano. The older analyses generally represent it as present. In the first Appendix to Dana's "Mineralogy" (1872), *oxammite* is mentioned amongst "other names given by Shepard for supposed new species consisting of oxalate of ammonia, ..." In the second Supplement to Watts's "Dictionary of Chemistry" it is stated that, "according to Chevreul, the crystallisable material dissolved from guano by cold water consists mainly of ammonium oxalate mixed with yellow, red, and brown organic colouring matters." On the other hand, several of the older analyses do not mention the compound at all, or substitute calcium oxalate for it. And in the *Journal of the Chemical Society* for January, 1875, p. 100, among the salts found by E. Chevreul in his late minute examination of guano are quoted calcium oxalate and ammonio-potassic oxalate, but not the simple ammonium salt.

A manufacturing firm placed in my hands a year or two a lump of material of crystalline appearance, weighing something more than a pound, taken from a bag of Guanapi guano, which qualitative examination showed to consist of nearly pure ammonium oxalate without other bases. In order fully to settle the question of its identity, and of the occurrence of this salt ready formed in guano, Dr. Tanner made a quantitative analysis of picked crystals, which were, however, so small (generally 1 or 2 millimetres long) that it was impossible mechanically to get rid of the whole of the brown organic matter encrusting and lying between the colourless crystals themselves. This impurity also interfered with determination of crystalline form.

The ammonia was obtained by Schlösing's method—expulsion by solution of sodium hydrate at ordinary temperature under a bell-glass, and reception in a known amount of standard sulphuric acid. Oxalic acid was precipitated by calcium acetate, and the calcium carbonate left on properly heating the precipitate weighed. Organic matter was left undissolved by the use of a small quantity of water.

Analysis gave—

NH_4	20·73
C_2O_4	50·35
Organic matter (with minute amount of ash)	5·54
H_2O (by difference)	23·38
	100·00

Deducting the organic matter, we have—

NH_4	21·95
C_2O_4	53·30
H_2O	24·75
	100·00

The ordinary crystallised salt, $C_2(NH_4)_2O_4.H_2O$, requires—

$(NH_4)_2$	25·35
C_2O_4	61·97
H_2O	12·68
	100·00

while the normal salt, with two molecules of water of crystallisation, $C_2(NH_4)_2O_4.2H_2O$, requires—

$(NH_4)_2$	22·50
C_2O_4	55·00
$2H_2O$	22·50
	100·00

University of Virginia, August 20, 1875.

MAGNETISATION OF ILMENITE (TITANIC IRONSTONE).

By Dr. T. L. PHIPSON.

Some fine specimens of ilmenite having been sent to my laboratory from Norway, it seemed a good opportunity to investigate the magnetic properties of this mineral. The composition of that which served in my experiments was:—

Titanic acid	24·60
Protoxide of iron	72·10
FeS_2	2·06
Manganese	trace
Silicic acid	1·24
	100·00

Its sp. gr. was 4·8, and it acted with tolerable energy upon the magnetic needle. From the inspection of this action I concluded that it was possessed of a very considerable number of poles in close proximity to each other, so that scarcely two closely adjacent parts acted in the same manner upon the north pole of the needle; hence it was evidently built up by a mass of crystals. An elongated rectangular piece of this mineral was separated by a blow of the hammer; it measured 1¼ ins. in length and was about ¼ in. broad. This was placed upon a table and submitted to magnetisation by friction with good magnets for upwards of an hour. It was then found to have a pole at each extremity, which it certainly had not before, and was accordingly suspended to a piece of silk, and hung up in a quiet corner of the laboratory. It pointed constantly towards the north, and returned to that position when deviated. It continued to do so for some weeks; but one morning I found it pointing east-west, or nearly so; it had lost its acquired magnetism entirely, having retained

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it for rather more than a month. This loss occurred rather suddenly, and I am of opinion that it coincided with a magnetic storm of some intensity which happened about the time. If these experiments could be continued by some who have more time to devote to them, they might lead to some interesting results. It is possible that some minerals that show no action upon the needle might be made magnetic in the above manner.

THE ESTIMATION OF NITRITES IN WATER.

By EDWARD NICHOLSON.

THERE are two reactions, by the aid of which liberated nitrous acid may be estimated:—

1. The reducing action on potassium permangate,
2. The reaction with potassium iodide.

The second reaction is by far the more sensitive; while 0·028 centigrm. of nitrous acid in a litre of water only requires 0·01 centigrm. of oxygen, yielded by 1 c.c. of the dilute standard permaganate solution, it liberates from potassium iodide 1·19 centigrm. of iodide, a quantity sufficient for accurate estimation either volumetrically or colorimetrically. Besides the failure of the permanganate reaction (Péan de St. Gilles's process) in the case of minute quantities perfectly estimable by the iodine reaction, the former is masked or simulated by the action of organic matter. Dr. Paul recommends to use the permanganate after ridding the water of organic matter by alum precipitation and boiling; but I find this treatment will frequently leave, if not all the organic matter, at least sufficient to simulate much nitrous acid when none is present. Dr. de Chaumont proposes (Parkes's "Hygeine") a converse device, viz., to expel the nitrous acid by boiling the water after acidifying, and to take the difference between the quantity of permanganate now required, and that used without the boiling as indicating the amount reduced by nitrous acid; but it is evident, amongst other objections, that in few cases with the reaction with organic matter (already unsatisfactory in itself), either admit of such refinements or be clear enough for any value to be attached to the difference which may occur between the two experiments. But except in the case where sulphuretted hydrogen is present in water (and even then it can be removed) the well-marked and very sensitive reaction of nitrous acid on potassium iodide is always applicable. There are three processes available:—

1. *Volumetric Estimation by Arsenious Acid.*—This is an application of a well-known class of determinations; 198 of arsenious acid will absorb 508 of iodine, which amount is liberated by 12·2 of nitrous acid (12·5 is probably the more accurate figure, the proportion being as nearly as possible 40 to 1); it may be taken that each c.c. of a centinormal solution of arsenious acid (1·98 gramme per litre) will absorb the iodine liberated by 0·0125 centigrm. of nitrous acid. I use the process in the following manner:—To 500 c.c. of the water, in a stoppered white bottle, add 5 c.c. of potassium iodide solution (one-tenth) and then 5 c.c. of dilute (one-tenth) pure sulphuric acid. Allow the reaction an hour for full development. If the iodine be liberated in very small quantity, or if it be masked by turbidity of the water, add a drachm of benzine or chloroform and agitate; the iodine will give it a pink colour which is quite as sensitive as the blue colour given by starch, and disappears more quickly when the iodine is absorbed. Under ordinary circumstances I use neither benzine nor starch, the yellow colour of the free iodine is sufficient. In order to estimate the iodine, neutralise the acid by a slight excess of sodium carbonate (caustic alkalies often contain nitrites), and drop in the centinormal arsenious solution until the iodine colour disappears.

2. *Mr. P. Holland's Colorimetric Process.*—This process is described in "Select Methods in Chemical Analysis." A solution of pure nitrite is prepared, containing 0·01 centigrm. of nitrous acid in each c.c. A solution of iodine (about 4 grammes per litre) in potassium iodide is also prepared, and adjusted of such strength that 10 c.c. made up to 200 c.c. with pure water shall produce the same colour as 10 c.c. of the standard nitrite solution made up to 200 c.c. with water containing potassium iodide and some dilute sulphuric acid. The iodine reaction being developed in a certain quantity of water containing nitrites (as in the preceding process) an equal colour is produced in an equal quantity of pure water by the addition of the standard iodine solution; each c.c. = 0·01 centigrm. of nitrous acid.

3. *A Simpler Colorimetric Process.*—Mr. Holland's process adds two standard solutions to those used in water analysis, besides giving the trouble of obtaining a pure nitrite. I dispense with these additions by the following simple process. It is founded on the liberation of iodine by a permanganate* under the same circumstances as its liberation by nitrous acid; 0·01 centigrm. of active oxygen contained in 1 c.c. of the dilute standard solution of permanganate commonly used (0·395 gramme per litre) liberates 0·16 (more correctly 0·159) centigrm. of iodine; while 0·01 centigrm. of nitrous acid liberates 0·40 centigrm. of iodine under the same circumstances. The application of this principle to colorimetric estimation is obvious; 0·01 centigrm. of active oxygen contained in 1 c.c. of the dilute standard permanganate solution will, in a comparative experiment, liberate the same quantity of iodine as 0·004 centigrm. of nitrous acid. Let the iodine reaction be produced, as in the first process, in 500 c.c. of the water under examination. When the colour is fully developed add in the same way potassium iodide and sulphuric acid to 500 c.c. of pure water, and then drop in the dilute standard permanganate solution until an equal iodine colour is produced. The development of the colour is immediate.

The first process is well adapted for laboratory work, especially as the arsenious solution is useful for other purposes besides water analysis. The third process is hardly less accurate; I devised it for use while travelling in India, in order to reduce the number of standard solutions carried about.

Carlisle Castle, Sept. 23, 1875.

ON THE PURIFICATION OF CARBON DISULPHIDE.

By SERGIUS KERN, St. Petersburg.

ORDINARY carbon disulphide (CS_2) has a very disagreeable odour, owing to the presence of some hydrogen compounds which are formed during the preparation of the product by the action of nascent hydrogen on the carbon disulphide. Beside this the compound often contains free dihydric sulphide (H_2S). In order to set the carbon disulphide free from the impurities it is well shaken up with mercury; but this *modus operandi* is a tiresome one and the product is not well cleaned.

The following method was found to be the best for cleaning impure carbon disulphide:—The impure product is well mixed in a high glass with some lead nitrate (Pb_2NO_3) and with a small quantity of metallic lead; when the salt turns dark, the liquid is poured into another glass with a fresh quantity of the lead salt, and so on until the salt remains nearly white while mixed with the liquor. The carbon disulphide is then placed in a retort, and distilled over into a well cooled receiver.

During these experiments a peculiar phenomenon was observed; when the salt was mixed in the crystalline form with carbon disulphide during 10—15 minutes, the crystals were covered with a silver-like precipitate. If these crystals placed on filtering paper are examined

* This reaction has, I need hardly say, nothing to do with the action of permanganate on nitrous acid.

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through a microscope they have a very beautiful appearance. These experiments are not finished, and if the results prove of interest they will be communicated.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.*

(Continued from p. 153.)

The temperature of the flame does not, however, depend exclusively on the heat of combustion. The density of the burning body and the specific heat of the products of combustion must also be taken into account. Hence it comes that the temperature of the hydrogen flame in pure oxygen is about 6800°, in air about 2600°; the temperature of the flame of carbonic oxide in oxygen amounts to 7000°, in air about 3000°;† further according to calculation 1 vol. of hydrogen = 1 grm. is capable of fusing 205 grms. of platinum, whilst the same volume of carbonic oxide can fuse 238 grms. of platinum (melting-point 2000°.) In practice, however, even under the most favourable conditions, as Deville and Debray determined in their researches on platinum, about half the heat is lost by conduction to the furnace and other surrounding matter, and the above authorities with 120 litres of hydrogen and 60 of oxygen succeeded in fusing only 1 kilo. of platinum instead of double the amount as calculated. Platinum can also be smelted and refined under similar circumstances with coal-gas. But for the more infusible metals of the platinum group, iridium, ruthenium, and their alloys, the hydrogen flame must be retained, which, if costlier than coal-gas, is cheaper than carbonic oxide.

In the use of gases as fuel the metal itself can be brought in contact with the flame, which is impracticable in case of carbon, and thus the great loss of heat is avoided which ensues when the crucible is heated from without. Their application renders it also possible to inspect the condition of the metal at any moment. In the metallurgy of the common metals these two advantages do not come into consideration. Carbon, moreover, is not only the cheapest but the most productive fuel,‡ and the application of hydrogen as a source of heat seems therefore limited to autogenous soldering and to the fusion of the most refractory platinum metals.

The property of platinum-black to ignite hydrogen, of which Döbereiner made a well-known and widely utilised application in his hydrogen lamp in 1823, has lost its practical importance owing to the discovery of friction matches.

The more intense and permanent was the interest which hydrogen created as a source of light.

As the luminous power depends on the temperature at which a solid ignited body is maintained the suggestion was near at hand to produce an intense light by means of this gas, in which an incombustible body was heated to whiteness. To this end the Scotch military engineer Drummond used in 1826 cylinders of caustic lime heated in the oxyhydrogen flame. The Drummond light has been widely employed, not merely in geodetic measurements and in lighthouses, which the inventor had principally in view, but also for projections of microscopic objects and photographic images on glass, or drawings upon gelatine for demonstration in lecture-halls,‖ for dissolving views, and chromatropes. In the American civil war it was used in sieges to light up forts.* The English war department has tried it in barracks, in large halls and courts, in which† it is said to have proved cheaper than coal-gas, whilst the smallest characters could be read at a distance of 90 metres from the source of light.

(To be continued.)

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† Debray, "Sur la Production des Températures Elevées et sur la Fusion de la Platine." Lecons de Chimie en 1861, 65; Paris, 1862.

‡ The calculated temperature of the flame of carbon in oxygen is 10,000°, from which has to be deducted the unknown amount of heat which at this temperature is lost by dissociation. See Debray, *opus citat.*

‖ This Report, p. 14; also H. Vogel, *Ber. d. Chem. Gesell.*, iii., 901.

ON THE MANUFACTURE OF WHITE CAUSTIC SODA.‡

By GEORGE E. DAVIS, F.C.S.

Although the manufacture of soda-ash is spread throughout the whole length and breadth of Lancashire, the manufacture of the hydrate commonly called caustic soda is concentrated in Widnes and St. Helens.

Books give us but little information upon the subject of white caustic soda, cream caustic is mentioned in a few; but even that was written upon when the manufacture was in its infancy; and though but little change has been made in this branch of late, still the chemistry of the process has received much development.

Before describing the process of manufacture in its chemical and physical details, I would wish to lay before you a short history of the manufacture, and if I am thought to be digressing from my path in first describing the history of cream or red-liquor caustic, it must be remembered that this was the forerunner of white, and that the development of the one led to the manufacture of the other.

Le Blanc's process as originally devised was for the production of carbonate of soda only, and was intended as a substitute for kelp or Spanish barilla; and when the artificial soda was introduced as vat-liquors simply evaporated to dryness and containing a large quantity of caustic soda, the presence of this latter compound was found seriously to interfere with the application of this variety in many processes where Spanish barilla or kelp was formerly used.

In the manufacture of soap, which was then a large trade, the presence of caustic soda in the commercial soda-ash was rather an advantage, as the soap lyes were produced by the soap maker himself by boiling a weak solution of soda-ash with lime, but for many purposes the caustic soda in the ash had to be carbonated, and the idea occurred to Gossage in 1853, or perhaps before that time, of separating the carbonate and other foreign salts by concentration and other means now well known, and leaving the hydrate in solution as red-liquors, from which solid caustic soda could be obtained by concentrating sufficiently.

Soon after this solid caustic soda entered the market, and became as staple an article of commerce as soda-ash had already become. The first attempts were what we should now call bad or discoloured caustic, and various means were patented from time to time to free the liquors from sulphides of both iron and sodium, and so produce caustic soda of good quality. In 1855 Stott patented a process for freeing vat liquors from sulphides by means of the oxides of iron, manganese, or zinc, and exactly the same thing was patented in 1857 by Gossage, and in subsequent years by many others. In 1857 we have a method patented by Bakewell for packing caustic soda in sheet iron drums, the article before that time being chiefly solidified by pouring it upon iron plates, breaking up and packing in casks or barrels. In some works after packing thus, the cask was filled up with the fluid caustic from the pots.

About this time the demand for caustic soda must have been greater than the supply, for we find manufacturers

* Wagner, "Lehrbuch der Technologie." 9th edit., ii., p. 377.

† *Journal of Gas-lighting*, 1869.

‡ From the *Journal of the Society for the Promotion of Scientific Industry.*

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turning their attention to the causticising of liquors by means of lime. Still this was only to supply the increasing demand for what we should now call "cream caustic," as no other kind but one was known then, and in 1858 four Thomas's obtained a patent for causticising with lime and oxidising the sulphides with air in one operation.

The increased dilution of the liquors then began to tell upon the cost of production, and in 1859 Dale obtained a patent for the process of concentrating the weak caustic liquors in steam boilers, and using the steam for various purposes.

Many were the patents obtained between 1853—1860 in connection with the manufacture of caustic soda, but they are of little interest, and no real improvement was made until some time after November, 1860, when Ralston patented the following improvements:—"If it is desired to produce a hydrate of great strength, evaporating and separating the foreign salts, but in place of keeping the heat low as hitherto, the evaporation is continued and the heat raised until the iron separates as oxide of iron, and until the oxide is precipitated to the bottom of the vessel, the clear alkali is then separated from the iron. The alkali will then be free from iron and of great strength."

It was also added that if the alkali was not required of so high a strength salt was to be added while in dry fusion, or in preference the foreign salts were not to be separated in the first instance.

This may be considered as the commencement of white caustic; that it was ever made before this is extremely improbable, from the fact that the early manufacturers used very thin pots for concentrating and finishing, and a manufacturer would scarcely have ventured to raise four or five and even six tons of caustic soda in them to the state of igneous fusion, and have kept the pot at that temperature during the time necessary for the setting of the oxide of iron. Again, it was known to most of the caustic soda manufacturers of that day, that the best colour was produced when the samples contained most water and a minimum of neutral salts; so they dared not concentrate to much above 60 per cent of alkali for fear of deteriorating their colour, and so producing an unsaleable article.

Even for some time after Ralston's patent fused or white caustic soda was very slightly known; the only publication concerning it of which I am aware was written by Dr. Pauli, and appeared in the Chemical News for 1862. Norman Tate mentioned this paper in an article to the *Pharmaceutical Journal*, September, 1862, which article was founded on a very interesting paper on caustic soda, read by Mr. Tate before the members of the Liverpool Chemists' Association, May 15, 1862; but white or fused caustic was but barely alluded to in his paper. Dr. Pauli, however, clearly indicated the process in June, which is followed to the present day.

In the early days of the white caustic manufacture, it was produced in some places by dissolving and causticising a soda-ash, and, in others, from diluted vat liquors; but in Richardson and Watts's "Technology" Pauli states the method used at the Union Alkali Works, St. Helens, where commercial caustic soda (presumably that obtained from the red liquors of Gossage's process) was "heated to fusion, and kept at that temperature through the night, when, besides the oxide of iron, the alumina is separated as a crystalline silicate."

This separation of alumina as a silicate I have never found to be the case with caustic from vat liquors causticised with lime, but from theoretical considerations there is a possibility of its happening with caustic from fused red liquors, which often contains a large proportion of silicate of soda.

About this time Messrs. Gaskell, Deacon, and Co. patented a process for producing crystals of caustic soda, of which an analysis is given in Richardson and Watts's "Technology;" but these crystals never became a commercial success. At the International Exhibition of 1862, there were several samples of caustic soda exhibited, some of which were undoubtedly cream, others were fused, and some among this latter class were easily detected by possessing the greenish tinge due to over nitreing.

The Jarrow Chemical Company, South Shields, exhibited caustic soda from the Newcastle district, while Lancashire was represented by Messrs. Gaskell, Deacon, and Co., Messrs. Hutchinson and Earle, Messrs. Roberts, Dale, and Co., and the Messrs. Muspratt of Liverpool, Flint, and Widnes. One exhibit came from the works of the Sambre and Meuse Joint Stock Mining Company. From Austria there were several exhibits of caustic soda; the sample exhibited by Messrs. Miller and Hochstadter being specially mentioned by the jurors as being very white.

Since this time the manufacture has become wonderfully extended; one firm in Widnes, when in full work, turning out equivalent to 250 tons of 60 per cent caustic per week, and several others from 60 to 80 tons each weekly. In St. Helens there are four or five works, with a weekly turn out of from 60 to 80 tons of 60 per cent each, and all this by causticising vat liquors with lime, which contrasts very unfavourably with the statement in Wagner's "Technology," that "the use of lime for the transformation of sodium carbonate into caustic soda has been abandoned long since" (1873).

Such is the history of white caustic soda. I will now turn to the present mode of manufacture in its most scientific form, starting with the black-ash process, and will divide the subject into five divisions, taking them as separate portions of one great whole.

1. Black ash-making; 2. Lixiviating the black-ash; 3. Causticising; 4. Concentrating; and 5. Finishing.

1.—*The Black-ash Process.*

Black-ash, as is well known to practical men, is made by fluxing together a mixture of salt cake, carbonate of lime in various forms, and slack. There are two sizes of balls generally worked in the trade and designated by the amount of salt cake the mixing contains. The first are of small size and are called twenty stone balls because they contain 2½ cwts. of salt cake; the second are of larger size, and are called twenty-four stone balls because they contain in the mixing 3 cwts. of salt cake.

In balls where the carbonate of lime is introduced as limestone the weight of this latter per ball is generally that of the salt cake employed; in some cases it is more, especially when used in the manufacture of caustic soda and in this case the proportion of slack is also more than when a soda-ash is made.

For caustic soda when twenty stone balls are worked the following is a mixing from actual practice:—

Salt cake	2·5 cwts.
Limestone	2·75 ,,
Slack	1·5 ,,

The slack used as it is for its carbon may vary considerably in its weight per ball. This will of course depend upon the amount of moisture present as well as upon the amount of ash left on ignition.

Another firm working twenty-four stone balls make up their mixing as follows:—

Salt cake	3 cwts.
Limestone	3 ,,
Slack	1·625 to 1·75 ,,

The number of balls drawn in different works varies considerably; some draw twenty-five small balls in the twenty-four hours from each furnace, whilst it is said that some draw from thirty to thirty-three; but when twenty-four stone balls are worked the general rule is twelve balls on the day shift and thirteen on the night turn. This is considered as good work, which should be performed regularly, producing a good and regular black-ash, lixiviating easily and containing a minimum of sulphate and sulphide.

Where chalk is used as the source of carbonate of lime, an extra quantity is required to make up for the water present, but as chalk is not used in the Widnes, St.

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Helens, or in the Manchester districts, the two former being the great seats of the caustic soda manufactures it is not necessary to enter into details. But where white caustic soda is made, the black-ash ball is compounded of several materials not included in the foregoing mixings. The lime mud from the causticising operation is made to replace its equivalent of limestone, and the salts which are separated at various stages of the concentration of the causticised liquors are also added in quantity varying with the rate of production.

In one works, where twenty stone balls were drawn, and making nothing but white caustic soda, the black-ash was made from the following mixing:—

Salt cake	2·5 cwts.
Lime mud	2·5 ,,
Limestone	1·5 ,,
Slack	1·5 ,,
Fished salts	14 lbs.

It was a good, regular black-ash, the analysis of which may be seen further in this section. Good balls have also been made from all lime mud after the following mixing:—

Salt cake	2·5 cwts.
Lime mud	5·0 ,,
Slack	1·5 ,,

Good balls have also been made from all salts and limestone, but this is a most expensive proceeding, as such a tremendous excess of limestone over the sulphate contained in the mixing is required to keep the ball stiff. The following is the mixing for all salts, but should not be employed, unless, first, either the stock of salt cake is worked up, or, secondly, it has become necessary to work up a large stock of salts:—

Fished salts	2 cwts.
Limestone	3 ,,
Slack	1·5 ,,

The fished salts would scarcely contain more than 0·7 cwt. of real salt cake; therefore, it may be readily seen what an expensive process this is.

These are all mixings for hand furnaces. Perhaps it will be thought I should have mentioned revolvers, but, as treating the subject properly would take too much time, and swell this paper into gigantic proportions, I leave the subject untouched.

(To be continued.)

SOCIETY OF PUBLIC ANALYSTS.

ON TEA.

By G. W. WIGNER.

THERE are so many varieties of tea imported into this country that, in order to ascertain their distinguishing chemical characteristics, it is necessary to analyse a large number of samples.

I have, therefore, determined to supplement a paper I published some months ago by the results of a large number of analyses made since.

The samples I have examined comprise, as well as the ordinary teas of commerce, certain rarer kinds, the characteristics of which are less generally known, and which will, perhaps, possess some interest for my brother Analysts.

The *moisture* of teas is generally considered a matter of little moment, and consequently is seldom determined.

It would appear, however, that it bears a certain relation to the individual kind of tea, and that its limits of variation are wider than is generally supposed; as I have found the proportion as low as 4·20 per cent, and as high as 10·80 per cent.

Tea is hygroscopic, and, when exposed to the air, after having been dried at a temperature of 212° F., will gain weight with considerable rapidity.

The table (see next page) shows the results of some teas so dried and then exposed to the atmosphere of my laboratory during parts of the months of February and March in this year.

It will be seen that the Hysons and Gunpowders, both of which are high-dried teas, contain the smallest amount of moisture—the two Hysons yielding, respectively, 5·68 per cent and 4·84 per cent, and the highest percentage yielded by a gunpowder being 6·55 per cent, and the lowest 4·94 per cent; while the Congous (which have already been dried at a lower temperature) give an average of 8·50 per cent. The average of the entire table is 7·67 per cent. The average weight of water re-absorbed after 11 days' exposure to the air is 6·93 per cent, deducting which from 7·67 shows that, taking the average, the samples regained by exposure to the air all their original weight of moisture, less 0·74 per cent.

The different classes of tea showed, however, strikingly different results. For instance, one sample of Congou, originally rather dry, gained moisture to the extent of 1·75 per cent *in excess of its original moisture*. Every other sample of Congou except one failed to reach its original weight, the average loss being about 1·7 per cent. Similarly, the Pekoes in every case but one show an ultimate loss to nearly the same extent. On the other hand, the high-dried teas, Hysons and Gunpowders, show an increase in every case, averaging more than 1 per cent.

The general tendency of this exposure to the air serves to bring the moisture of the whole to an average of about 7 per cent; but the limit of difference after exposure is very much narrower than before, the range of moisture before drying being 5·96 per cent, and after drying and exposure to air, 2·62 per cent. In my previous paper I gave the results of the partial analysis of the ash of twenty-four samples of genuine tea of ordinary character, and also of four samples of special growths of tea.

The list of ordinary teas may with advantage be increased, and for the information of those who may not be familiar with the *appearance* of the rarer teas, it is yet more important to record the chemical results of such samples.

I therefore subjoin a tabulated statement showing the results of the analysis of seventeen more samples of ordinary teas, and of eighteen samples of what I may term uncommon, or special teas.

The number attached to each remains constant to the respective sample in the other tables which I give.

The "special" teas were all taken from original packages, and had, therefore, undergone no manipulation in this country. They were mostly of high price, and, being only imported for the purpose of "mixing," would not by themselves yield a pleasant infusion.

These analyses have all been made on a uniform plan, viz., igniting 100 grains of the tea, boiling the ash in 5 ounces of water, and washing on the filter with cold water. The alkali is estimated by adding excess of normal acid and titrating back.

Ordinary Teas from Original Chest.
(Partial Analysis of Ash.)

No.	Description.	Total Ash. Per cent.	Soluble in Water. Per cent.	Soluble in Acid. Per cent.	Silica.	Potash.
36	Indian	5·58	3·06	2·20	0·32	1·45
27	,,	5·82	2·75	2·87	0·20	1·36
38	Congou	5·96	3·12	2·68	0·16	1·65
39	,,	5·63	3·25	2·08	0·30	1·41
40	,,	5·89	3·10	2·04	0·73	1·27
41	,,	5·83	3·03	2·04	0·76	1·32
42	,,	5·65	3·07	2·27	0·31	1·37
43	,,	5·61	2·75	2·33	0·53	1·27
44	,,	5·71	2·75	2·33	0·63	1·17
45	,,	5·76	2·82	2·50	0·44	1·26
46	,,	5·92	3·25	2·08	0·59	1·41
47	,,	5·78	3·08	2·04	0·66	1·17
48	,,	6·03	3·35	1·99	0·69	1·17
49	Gunpowder	5·75	3·10	2·34	0·31	1·32
50	,,	5·64	3·11	2·14	0·39	1·36
51	Hyson	5·69	3·35	2·18	0·16	1·18
52	Congou	5·53	3·32	2·06	0·25	1·60
	Average	5·75	3·07	2·25	0·43	1·38
	Maximum	6·03	3·35	2·87	0·76	1·68
	Minimum	5·53	2·75	1·99	0·16	1·17

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MOISTURE AND HYGROSCOPIC PROPERTIES OF TEA.

No.	Description.	Weight of 100 Grs. dried at 212° F.	Water.	Weight after Exposure to the Air in Open Vessel for— Four Days.	Six Days.	Eight Days.	Eleven Days.	Total Gain of Weight after Exposure to Air.
1.	Indian young Hyson.. ..	94·32	5·68	97·57	99·80	100·54	100·88	6·56
2.	Moyune ,, ,, ...	95·16	4·84	98·92	101·25	101·25	101·25	6·09
3.	Gunpowder	95·06	4·94	100·68	101·01	101·17	101·10	6·04
4.	Moyune guupowder	94·84	5·16	98·54	100·63	101·07	101·31	6·47
5.	,, ,, ...	94·30	5·70	98·22	100·35	100·50	100·50	6·20
6.	,, ,, ...	93·82	6·18	97·83	100·09	100·52	100·77	6·95
7.	,, ,, ...	93·45	6·55	97·42	99·67	100·44	100·43	6·98
8.	Medium Oolong (1874) ..	93·70	6·30	99·85	100·02	100·26	100·22	6·52
9.	Oolong	93·23	6·77	97·88	99·99	100·45	100·89	7·66
10.	Manuna (fine)	92·91	7·09	98·32	98·61	98·88	98·90	5·99
11.	Broken Indian	92·70	7·30	97·43	93·87	100·41	100·24	7·54
12.	Fine Kaisow	91·40	8·60	98·48	98·36	98·76	98·59	7·19
13.	Kaisow (1870)	89·48	10·52	96·26	96·49	96·73	96·66	7·18
14.	,, ,, ...	89·20	10·80	96·79	96·82	96·89	96·67	7·47
15.	Orange Pekoe	94·42	5·58	98·45	100·64	101·00	101·22	6·80
16.	Indian ,, ...	93·13	6·87	99·49	99·70	99·91	99·93	6·80
17.	Scented orange Pekoe ..	92·21	7·79	98·12	98·25	98·39	98·32	6·11
18.	So Pekoe (1869)	90·61	9·39	96·64	97·06	97·31	97·29	6·68
19.	Pekoe siftings	90·55	9·45	96·81	96·86	96·92	96·80	6·25
20.	Consolidated	91·89	8·11	96·58	98·65	98·95	99·14	7·25
21.	Indian Souchong	91·84	8·16	98·14	98·35	98·58	98·46	6·62
22.	Caper	93·20	6·80	98·30	98·00	98·60	99·00	5·80
23.	,, ...	93·00	7·00	98·90	98·20	99·00	99·00	6·00
24.	,, ...	92·00	8·00	98·60	98·20	98·30	98·90	6·90
25.	,, ...	92·00	8·00	99·00	98·20	98·80	98·90	6·90
26.	,, (1872)	91·48	8·52	98·26	98·47	98·63	98·47	6·99
27.	Indian Congou	93·44	6·56	98·41	100·93	101·58	101·75	8·31
28.	Congou..	92·72	7·28	97·25	99·57	100·00	100·08	7·36
29.	,, ...	91·94	8·06	96·41	99·39	99·54	99·68	7·74
30.	Moning Congou	91·51	8·49	99·00	99·00	99·33	99·09	7·58
31.	New District	91·36	8·64	96·71	99·62	99·78	99·78	8·42
32.	Moning	90·92	9·08	98·76	97·84	98·08	97·97	7·05
33.	Congou..	90·83	9·17	98·56	98·32	98·40	98·21	7·38
34.	,, (1869)	89·96	10·04	96·67	96·72	97·04	96·87	6·91
35.	,, ...	89·67	10·33	96·65	96·80	96·85	96·62	6·95

Putting these results with those of the twenty-four samples previously published, we find—

	Total Ash.	Soluble Aqua.	Soluble Acid.	Silica.	Potash.
Average ..	5·69	3·03	2·22	0·44	1·49
Maximum ..	6·03	3·35	2·87	0·78	1·88
Minimum ..	5·46	2·67	1·97	0·15	1·17

These results from forty-one different pure samples may be certainly assumed to represent fairly the ordinary teas of commerce as imported.

I pass now to the special samples, which vary in price but are generally high, Nos. 1, 2, 4, 6, 7, and 53 ranging between 3s. and 3s. 6d. per lb. in bond.

Special Teas from Original Chests.

No.	Description.	Total Ash.	Soluble in Water.	Soluble in Acid.	Silica.	Potash.
		p.ct.	p.ct.	p.ct.	p.ct.	p.ct.
1	Indian young Hyson	5·32	3·27	1·94	0·11	1·69
2	Moyune ,, ,,	5·75	3·71	1·74	0·29	1·83
4	Moyune Gunpowder	5·83	3·67	1·83	0·33	1·51
5	,, ,,	5·61	3·22	2·11	0·28	1.56
6	,, ,,	5 63	3·44	1·81	0·38	1·51
7	,, ,,	5·50	3·51	1·80	0·19	1·51
8	Medium Oolong ('74)	6·34	3·59	2·23	0·51	—
9	Oolong	5·27	3·15	1·83	0·29	1·51
10	Naununa (fine)	6·80	3·80	2·60	0·40	1·32
11	Broken Indian	5·17	2·92	2·21	0·04	1·96
12	Fine Kaisow (1874)	6·46	3·43	2·46	0·37	1·41
17	Scented orange Pekoe	6·84	3·30	2·68	0·86	1·26
21	Indian Souchong	5·60	3·49	1·86	0·25	—
53	Oolong	5·49	3·88	1·33	0·28	1·46
54	,,	5·54	3·78	1·63	0·13	1·51
55	Assam	5·55	3·36	1·97	0·21	1·60
56	Java	5·54	3·26	2·24	0·04	1·36
57	Moyune siftings	6·16	3·20	2·38	0·38	1·74
	Average	5·80	3·44	2·04	0·32	1·39
	Maximum	6·80	3·88	2·68	0·86	1·96
	Minimum	5·17	2·92	1·33	0·04	1·26

I have kept the capers in a separate list because, although this class of tea is the one most frequently adulterated, yet it is perfectly possible to procure pure samples. The following table fairly shows the character of pure caper teas:—

Genuine Capers.

No.	Description.	Total Ash.	Ash Soluble in Water.	Ash Soluble in Acid.	Silica.	Potash.
23	Caper	5·90	3·16	1·86	0·88	1·42
74	,,	6·94	2.66	2·61	1·67	1·50
75	,,	7·02	3·66	1·96	1·40	1·32
76	,,	5 75	3·00	1·88	0·87	1·32
77	,,	5·73	2·64	2·41	0·70	1 41
78	,,	6·22	3·10	2·20	0·92	—
79	,,	6·23	3·10	2·37	0·76	1·53
80	,,	6·33	3·44	2 10	0·79	1·32
81	,,	6·11	2·85	2·36	0·90	1·08
	Average	6·25	3·07	2·19	0·99	1·35
	Maximum	7·02	3 66	2·61	1·07	1·53
	Minimum	5·75	2·64	1·86	0·70	1·08

Putting these results in the same average with the other special teas, the figures are—

Average of 25 Special Teas.

Average ..	5·95	3·33	2·09	0·53	1·38
Maximum ..	7·02	3·88	2·68	1·67	1·96
Minimum ..	5·17	2·64	1·33	0·04	1·08

These results are sufficient in number to give not merely a fair average, but a very good basis for assuming what are the maximum deviations likely to be met with in genuine tea.

It is possible to find samples of dried tea-leaves which would show slightly greater deviations from the average than even the special teas enumerated here, but such samples are not commercially met with. For instance, I believe from certain old samples which I have examined,

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that some teas which have been in bond for many years, and were probably of very inferior quality originally, may occasionally be found which deviate a few hundredths, more or less, from these figures, but such tea is practically unsaleable, and may be left out of consideration. And, on the other hand, it may be possible that some kinds of tea, such as Russian overland, may show even more soluble ash. Still, as my samples would in many cases be retailed as high as 6s. per lb., I think we may fairly exclude all higher priced teas.

(To be continued)

CORRESPONDENCE.

A MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—Indeed I do not "*object*" to the title of the proposed Mineralogical Society. Its "*breadth*," as Mr. Collins puts it, is ample enough. I only think the title rather too long for ordinary use. But, having just risen from the compilation of a Dictionary of Mineral Synonyma (some 10,000 or 12,000 British and Foreign, which I propose as my first contribution to the new Society), I may be excused, if, for a time, I have "nomenclature on the brain" rather, and prefer *short* names to long names whenever they are appropriate. Many ordinary people prefer "taking a 'bus," to "taking an omnibus." Many eminent geologists speak in a homely way of "beds" and "basins." And there are some eminent chemists who still talk familiarly of "potash" and "soda." Why should they not? Most people like to shorten the journey to desirable places, and why may they not do ditto to scientific ideas?

But everybody knows that it is quite possible to carry even *expressive* words to an uncomfortable length. I append examples of such anti-telegraphic verbal elongation. I do not, however, put them as trifles to smile at. Although a matter of small importance, allow me to say that I, for one, am quite content to take Mr. Collins's title as it stands.

Anyhow, let there be a Mineralogical Society in *fact*.

True, the notion is in its early day yet; but already a goodly array of hard-working mineralogists have given in their adhesion to the movement, who will be joined by a good many more at noon-day I fancy. This looks like the advent of business. A Mineralogical Society is certain to be formed, and mainly of earnest workers. That they *will work* there is not the slightest shadow of a doubt. They mean to do *meritorious* work too I expect, and when they shall have done so, as a consequence, the Society will stand a chance of being known as "*The* Mineralogical Society" *par excellence*.—I am, &c.,

T. A. READWIN.

Liverpool, September 27, 1875.

P.S.—"Nickelthoneisenzinksilicat."

"Sehr verworren schiefriger thonglimmerschiefer."

"Hydrochloride of ethenylbromophenylenediamite."

"The anti-leaving-little-fatherless-responsibilities-at-other-people's-door-Society."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 9, August 30, 1875.

Tenth Notice on the Electro-conductivity of Bodies Sparingly Conductive.—M. Th. du Moncel.—The strength of the current traversing certain minerals increases with the time that the circuit remains closed, whilst in other species it diminishes. This is especially the case with soft and porous stones. Minerals both hard and soft, with certain exceptions, among which may be ranked such as have undergone the effects of fire and of crystallisation, absorb more or less moisture from the air, and become conductive under its influence. Calorific effects always result in decreasing or destroying the conductivity of minerals.

Germination of the "Chevallier" Barley.—M. A. Leclerc.—A controversial paper, rather physiological than chemical, in reply to an essay by M. Deherain. See *Comptes Rendus*, lxxxi., p. 198.

Formation of Aniline-Black by the Electrolysis of its Salts.—M. J. J. Coquillion.—It is known that aniline-black is obtained by dissolving a salt of aniline in water and adding chlorate of potash and a metallic salt. Sulphide of copper and sulphate of iron are particularly recommended, and according to the majority of authors the presence of a metallic substance is indispensable for the production of aniline-black. The author proposes to show that aniline-black may be obtained without the intervention of any metal, simply by the action of nascent oxygen upon certain salts of aniline. For this purpose he submitted these salts to electrolysis and obtained the following results:—If a concentrated solution of sulphate of aniline is submitted to the action of two Bunsen elements with platinum electrodes, the positive pole is soon covered with a violet-blue pellicle, greenish in certain parts, as was observed by Litheby (? Letheby). But if the experiment is prolonged for twelve to twenty-four hours there is found fixed to the positive pole a black adhesive substance. On treating this substance with ether and alcohol and drying it in the stove there remains a black amorphous matter with greenish reflections, insoluble in most solvents. If this body is treated with sulphuric acid and spread out in a thin layer it takes a greenish colour, but in contact with alkalies it returns to a velvet-black. Nascent hydrogen has no effect upon it. To be sure that the production of this black was due to the nascent oxygen and not to the platinum serving as an electrode, the author used electrodes made out of gas-coke and obtained identical results,—a black mass being fixed to the positive pole, whilst bubbles of hydrogen were found around the negative pole. Nitrate of aniline gave also a black deposit, which in contact with alkalies took a velvety appearance, but was decomposed by sulphuric acid, with a maroon-brown colouration. Hydrochlorate of aniline gave a clotty black product at the positive pole, but in this case the results are probably complicated by nascent chlorine. Acetate gave a black clammy substance at the positive pole, but with the tartrate of aniline there was no result, not even the slightest colouration. Hence it appears that aniline black may be obtained without the intervention of any metal, and that the salts of aniline behave in different manners in presence of nascent oxygen.

No. 10, September 6, 1875.

Study of the Cold Bands of Obscure Spectra.—MM. Desains and Aymonet.—If we disperse, by means of a prism of rock salt, a slender pencil of rays coming from a Drummond lamp, and study the distribution of heat in the spectrum thus obtained, we do not detect cold bands similar to those of the solar spectrum. They may, however, be developed. For this purpose the rays are forced to traverse before their incidence upon the prism suitably chosen absorbents. This fact has been established by one of the authors some years ago. In their more recent experiments they have made use of the lamp of Bourbouze and Wiesnegg as superior to that of Drummond. With a spectrum of rock salt of 60°, the rays having traversed a centimetre of water and the lenses of the apparatus being of rock salt, they discovered in the obscure part of the spectrum four cold bands, the respective distances of which from the red were 19·8′, 30·6′, 42′, 52′.

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Eleventh Note on the Electro-conductibility of Moderate Conductors.—Th. du Moncel.—The first conclusion which the author draws from his experiments is that minerals, like the major part of moderately conductive bodies capable of being affected by the air, possess two sorts of conductivity; the one electro-tonic, relating to the matter itself of which the bodies are composed, and an electrolytic conductibility relating to the moist layer which lines the sides of the porous interstices. We may therefore conclude that the secondary effects which are the consequence of these two kinds of conductivity must meet simultaneously in minerals, and as these have a very different electrostatic capacity, and as their power of absorbing atmospheric moisture is very variable according to their molecular texture and their nature, it results that in some of them the electro-tonic conductivity predominates, and in others the electrolytic.

Les Mondes, Revue Hebdomadaire des Sciences, No. 1, September 2, 1875.

This issue contains no original chemical matter save the description of a new burette invented by M. Maumène, This paper should have been accompanied by an illustration, which the editor states has been mislaid.

No. 2, September 9, 1875.

This issue contains no chemical matter.

M. Reimann's Farber Zeitung, No. 33, 1875.

The Stettin Poisoning Case.—It is suggested that the poison here, if any, may be not the dye of the leather lining, but the mercurous nitrate employed in getting up the hare's hair, of which the hat was made.

Poppy-red for Artificial Flowers.—Thin cotton tissues are brushed over with a mixture of corallin-lake ground up with water and thickened with gum, 5 grms. of calcined magnesia per litre being added before use.

Production of Cochineal in the Canary Islands.—This crop is no longer remunerative, prices having fallen from 11 to 12 francs per Spanish pound (460 grms.) in 1848 to 2¼ francs at the present date. Many planters are rooting out the nopals, as there is little prospect of the trade again becoming remunerative. The total exports from the Canaries in 1873-74 were 2,340,348 kilos., of which 1,452,030 kilos. were sent to England.

There are receipts for a black on wool capable of resisting scarlet dye; a slate grey for the same material; a brown for silks, and a mill-fast black for cotton.

Moniteur Scientifique, du Dr. Quesneville, September, 1875.

Review of the Methods of Analysing Commercial Products.—M. A. G. Pouchet.—The author treats first of the analysis of sulphur ores, in which he states that errors of 1¼ to 4 per cent are often made if the nitric acid employed in oxidising the sulphur is not driven off by the subsequent application of an excess of hydrochloric acid. If this precaution is omitted, the sulphate of baryta thrown down in presence of free nitric acid is somewhat soluble, and if abundantly washed, the result is too low. If, on the other hand, the washing is but slight, a quantity of nitrate of baryta may remain mechanically mixed with the sulphate, and the result is too high. The author then describes in succession processes for the assay of nitrate of soda, sulphate of soda—his processes for which call for no remark—common salt, hydrochloric acid, chloride of lime, and chlorate of potash. For the last-mentioned he takes 10 grms. of the sample, dissolves in 100 c.c. of water, and adds 250 c.c. of a saturated solution of sulphurous acid. It is heated at first gently, and then up to a boil to expel the excess of sulphurous acid, and when all odour of this gas has disappeared it is allowed to cool and made up to 500 c.c. with distilled water. In 10 c.c. of this solution the chlorine is determined in the ordinary way with normal nitrate of silver. One part of chloride of sodium = 100 c.c. of the normal silver solution corresponds to 2·1 of chlorate of potash. For the assay of clays for alum making he proceeds as follows:—A mean sample of 50 grms. is taken and placed in a tared platinum or porcelain capsule. It is submitted to a moderate calcination. When it has attained a dull redness, the capsule is withdrawn, let cool, and weighed. The loss indicates the proportion of moisture and of volatile matters (combined water and organic matter). Upon the calcined clay are then poured 100 grms. of sulphuric acid at 60° B., the whole is well mixed with a glass rod, and heated till it becomes solid. It is then lixiviated with boiling water, and the alumina is determined in the ordinary manner in a known part of the solution. The author next treats of the salts from the mother-liquors of brine-pits, sulphate of potash, and ammoniacal salts.

MISCELLANEOUS.

Index to Mineralogy, &c.—An Index to Mineralogy, by Mr. T. A. Readwin, is ready for publication. The contents are:—

1. Table of the elementary substances (elements), with their chemical symbols, alphabetically arranged.
2. Table of mineral species and varieties (2816), alphabetically arranged, with concise references to their chemical composition, and place (when) in the Mineral Collection at the British Museum, *and copious explanatory appendix.*
3. Table of the simple minerals which frequently of themselves form rock-masses, or which enter largely and conspicuously into the composition of mineral aggregates (known commonly as *Rocks*), crystallographically arranged, with chemical analyses and formulæ.
4. Table of the elements in the order of their discovery, explanatory of their properties, history, sources, &c.
5. Table showing the known *associations* of the elements in mineral species.
6. Dictionary of mineral synonyma, British and Foreign (about 10,000).

An Index to Geology, by the same author, is also ready. Its contents are:—

7. Table of the simple minerals, which enter largely into the composition of rocks, chemically arranged.
8. Table of mineral aggregates or rocks, showing their composition, &c., alphabetically arranged.
9. Table of rocks, classified as to their modes of occurrence, sedimentary and otherwise.
10. Table of the systems, formations, and typical groups of strata, showing their characteristic rocks, minerals, and fossils.
11. Table of the British rocks, showing their estimated thickness, chief localities, commercial uses, &c.
12. Dictionary of rock synonyma, British and Foreign (about 3000).
13. Table showing the proximate mineral composition of plants and animals, alphabetical.

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ALEX. MOORE, Secretary.

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THE CHEMICAL NEWS.

Vol. XXXII. No. 828.

THE NATURE OF MUREXAN.

By JAMES REOCH, M.A., M.B.

In my last paper on "Murexide," in the Chemical News, vol. xxx., page 265, I defended Liebig's view of its amide nature; his ideas as to the non-acid character of murexan seem, on the whole, to be equally well founded. When murexide is dissolved in KHO or NaHO, and boiled till the purple colour changes to yellow, a precipitate is always easily obtained by adding an excess of acid, while if the murexide be boiled with acid, a precipitate may be obtained on cooling, if the solutions be concentrated, but if not, no precipitate is obtainable merely by adding an alkali. Liebig, followed by Gmelin and others, seems not to have distinguished these two cases, but I have already shown that the precipitate obtained by adding acids is essentially alloxantin, while that got by adding acid to an alkaline solution is very different, and to it properly belongs the name of murexan. Now when murexide is boiled with an alkali, a quantity of NH_3 is given off, and the fluid is gradually decolourised; if an acid be now added, a yellow crystalline precipitate is obtained, HCl,H_2SO_4. Acetic or malic acid may be used, but acet. fort. is for most purposes preferable to the mineral acids in dealing with easily decomposable organic principles. The crystals obtained by this acid are very peculiar, and much more complicated than the majority of the uric acid series, being like a square sheet of yellow paper with the corners rounded off, and two opposite corners curled up facing one another; all the other acids give some crystals similar to these, but they are generally more elongated, and sometimes arranged in rosettes. The formula for murexan has been very variously given.

Liebig gave C 33·3 per cent, H 3·7, and N 25·7. In three analyses for the C, I obtained 33·4, 34·4, and 32·2, the average being 33·3 per cent. This agrees with Liebig's analysis, but the amount of H and N differ widely. I found—

H 4·60	N 28·9
4·20	27·9
4·39	28·1
4·31	27·2
4·80	
4·80	

The average of these results gives 4·5 for the H and 28 for the N. The difference might be explained if Liebig adopted one of the two methods given for purifying murexan, by dissolving it in strong H_2SO_4 and precipitating by H_2O. In this case there is a tendency to the abstraction of NH_3 by the H_2SO_4, and substitution of more oxygen by exposing the murexan twice in the water-bath; it is thus rendered more, instead of less, impure. Whether or not this will fully explain the low N determination of Liebig, at any rate these analyses of the N agree better with those of Kodweiss, Beilstein, and others. The whole analysis agrees with the formula $C_4H_6N_3O_3$—

		Calculated.	Experiment.
C_4	= 48 =	33·30	33·3
H_6	= 6 =	4·16	4·5
N_3	= 42 =	29·16	28·0
O_3	= 48 =	33·30	34·2
	144	100·00	100·0

This formula appears also to explain the reactions of murexan, which is closely allied, though not identical, with uramil. Some chemists have maintained their absolute identity, but the crystalline form is entirely different, and the colour is also different, uramil being chiefly white and murexan yellow. Nor is uramil precipitated from an alkaline solution by an acid. The formula of uramil, also, as given by Liebig, differs from that of murexan as given above by H_2, though the agreement is sufficiently close to explain how murexide is derived from murexan in the same way as from uramil, for though there is no general agreement as to the formula of murexide, yet if supposed to be derived from uramil by simple oxidation and deprivation of H_2O, it would be derived from murexan in exactly the same way. That murexan has great affinity for O is easily proved by dissolving it in liq. potass., when it will absorb oxygen from many metallic oxides if boiled with them. These oxides vary greatly in the ease with which they surrender oxygen, but three may be singled out to typify the others, Ag_2O is one of the class most easily reduced, for a vast number of organic bodies reduce the Ag_2O precipitated from $AgNO_3$ by liq. potass. to the metallic state. Cu_2O is produced with greater difficulty from CuO; few bodies can accomplish this deoxidation, but among them we have lactose and glucose. The most difficult deoxidation is the production of the blue oxide of molybdenum from molybdate of ammonium; glucose will not reduce it, though nascent H will do so easily. Now these three deoxidations are all easily accomplished by alloxantin, uramil, and murexan, showing that they all have an affinity for O exceeding that of glucose; but this seems to be more especially the case at boiling temperatures, or at least they readily pass into other bodies and surrender their O again, for if murexan be boiled with $CuSO_4$ and excess of alkali, though the suboxide appears copiously thrown down, yet the next day much less appears, it having probably been re-dissolved to form a copper salt of an organic acid derived from murexan. As to the intimate nature of murexan, we find that in some respects it resembles an acid, but scarcely so much as to justify the name of purpuric acid given by Prout. It is soluble in alkalies, and is easily precipitated therefrom in a crystalline condition by acids, and so far, therefore, resembles uric acid, but in other characters it more resembles an amide. Thus on boiling it with alkalies or with acids, NH_3 may in either case be detected by Nessler's test, and it is also very unstable in solution, for if its KHO solution be divided into two parts, and to one acetic acid added to-day and to the other half to-morrow, there will be a much smaller precipitate in the latter case, possibly from its absorbing oxygen from the air. While, therefore, it would be premature to discuss the general relations of the murexide compounds, it does not seem that any valid objections to the experiments of Liebig have been sustained.

ON A NEW REAGENT FOR GOLD.

By SERGIUS KERN, St. Petersburg.

Studying the action of sulphocyanates on some double salts of gold I have found a remarkable delicate test for gold; experiments prove that even less than 0·001 gramme of gold may be easily detected by using my reagent.

The gold of the sample under analysis is first separated from foreign metals and next converted by means of sodium chloride into sodio-gold chloride ($NaAuCl_4$); the solution is then concentrated by evaporation. In order to detect gold an aqueous solution of potassium sulphocyanide (KCyS) is used, containing for one part of the salt about 15 to 20 parts of water. About 6 grammes of this solution are poured into a test-tube and some drops of the concentrated solution obtained by treating the sample as described above are added. If gold is present a red-orange turbidity is immediately obtained which soon falls in the form of a precipitate; on

gently heating the contents of the test-tube the precipitate dissolves and the solution turns colourless.

The reagent is so delicate that one drop of a solution of sodio-gold chloride (1 gramme of the salt dissolved in 40 grammes of water) gives a very clear reaction.

This reaction showed the existence of very interesting double sulpho-cyanides of gold; researches in this direction are being continued, and when finished the results of the experiments will be communicated.

REPORT ON

THE METHODS EMPLOYED IN THE ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS, AND ON THE MODE OF STATING THE RESULTS.*

(Continued from page 160.)

Solution of the Manure and Separation of Silica.

IN the case of soluble phosphates, treatment with cold water, with (in some cases) subsequent washing with hot water, seems universal. Most chemists prefer to take a considerable quantity of the manure, and grind it with small successive quantities of cold water in a mortar. An aliquot part of the filtered solution is taken for analysis.

With but one or two exceptions hydrochloric acid is universally employed for effecting the solution of insoluble phosphates.†

In the great majority of cases they then recommend evaporation to complete dryness. Some operators omit this step, as a rule, but classify it among the precautions necessary when great accuracy is required. The effect of evaporation to dryness is considered to be two-fold. Silica is rendered insoluble, and fluorides are decomposed with volatilisation of hydrofluoric acid, or of fluoride of silicon. The residue is next treated with hydrochloric acid in the ordinary manner, and the insoluble silica‡ filtered off.

Oxalic Acid Method.

Of the chemists whose processes of analysing phosphates have been communicated to the Committee, a decided majority precipitate the phosphoric acid as the double phosphate of magnesium and ammonium, after previously separating the calcium as oxalate.

Although there is no great difference in the general outlines of the method followed, the most extraordinary variations occur in the details of the instructions, and in the precautions recommended to ensure accuracy.

By far the greater number of chemists precipitate the calcium as oxalate after neutralisation of the excess of acid. Some add citric acid previously to employing oxalate of ammonium. According to Mr. R. Warington, this modification occasions a deficiency of lime, oxalate of calcium being soluble in citrate of ammonium. Those chemists who add citric acid before precipitating the calcium usually employ an acetate to get rid of free mineral acid. Of course the addition of citric acid then becomes a necessity when iron and aluminium are present, unless the precipitated phosphates of these metals are filtered off and estimated separately. This plan appears to have several advantages, and is recommended by some chemists of wide experience. By employing it the phosphates of iron and aluminium (by most chemists believed to have a very limited manurial value) are separately estimated, and the subsequent addition of citric acid is rendered unnecessary, and the error introduced by its use avoided. If the phosphates of iron and aluminium are not previously separated, the general plan is to neutralise the solution with ammonia until a slight turbidity ensues, to clarify the liquid by the addition of a few drops of oxalic acid, to add a moderate excess of ammonium oxalate, to heat the liquid nearly to boiling, and to filter off the precipitated oxalate of calcium. Some chemists filter again after cooling. After careful washing of the precipitate, the filtrate is usually concentrated, a moderate quantity of citric acid added, and then excess of ammonia. A precipitate may here occur of silica, fluoride of calcium, or oxalate of calcium. The more careful analysts leave the solution for a time to make sure that the liquid remains clear, and filter from any precipitate.

Precipitation by Magnesia.

The clear solution is next precipitated by "magnesia mixture," which is universally admitted to be better made with chloride than sulphate of magnesium. It is also clearly proved, and generally recognised, that a large excess of the precipitant should be avoided, some chemists recommending a preliminary analysis of the sample with the view of adding the approximately theoretical quantity of solution. On the other hand, it has been proved that complete precipitation is very slow except in presence of a considerable excess of "magnesia mixture." Very great variation occurs with respect to the concentration and temperature of the solution at the time of precipitation. A few chemists recommend precipitation in a hot solution, but the majority direct precipitation in the cold. One or two recommend the use of a dilute solution, while others concentrate, if necessary, to a certain bulk; and some make a correction for the solubility of the double phosphate in the liquid.

The amount of free ammonia present during the precipitation varies from a moderate excess to one-fifth of its bulk of the strongest ammonia (0·880).

The time allowed for the precipitation varies from ten minutes (with vigorous stirring) to twenty-four hours, but most chemists are of opinion that six or eight hours are sufficient.

Very few chemists recommend that the double phosphate should be dissolved in acid and re-precipitated.

But few precautions appear to be taken in the ignition of the precipitate. The more careful analysts thoroughly dry the precipitate and remove it from the filter, igniting it first gently and then intensely.

Very different opinions are held as to the accuracy of the results obtained by precipitation with magnesia. In many cases the observers are merely able to say that the process gives fairly constant results on repetition. In other cases they state that very concordant results have been obtained when the same sample has also been analysed by some chemist of repute.

In some cases the observers consider that the process is liable to give results somewhat below the truth, owing to the slight solubility of the double phosphate in the mother-liquid, and the loss of phosphate in the oxalate of calcium precipitate. In other cases the process is said to give results in *excess* of the real amount, owing to the presence of other magnesium salts or of iron or aluminium, in the double phosphate precipitate.

A most elaborate series of experiments has been made by Mr. T. R. Ogilvie on the magnesia process and the variations to which it is liable.* His results have been to a great extent confirmed by the researches of Mr. E. M. Dixon. On the other hand, Professor Church writes:—"My confidence in this plan, when carried out successfully, giving time for any oxalate to fall after addition of citric acid and excess of ammonia, is not shaken by Ogilvie's results reported recently in the CHEMICAL NEWS.

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* Presented to the British Association, Bristol meeting. Report of a Committee of Section B, consisting of E. C. C. Stanford, Chairman; James Dewar; Alfred E. Fletcher; and Alfred H. Allen, Hon. Secretary.

† It is evident that the addition of a few drops of nitric acid is desirable here to ensure the complete peroxidation of any ferrous compounds which may be present.

‡ It is evident that in presence of fluorides the silica here found will not strictly represent the quantity originally present in the sample.

* CHEMICAL NEWS, vol. xxi., p. 205; *Proceedings of the Philosophical Society of Glasgow* (Chemical Section), 1874 and 1875; &c.

His experiments seem to me to exaggerate the errors of the method greatly. Several times have I got identical results by the use of the molybdic method for separating the P_2O_5 from the soluble part of a superphosphate, and by the use of the oxalic acid method. I always use a measured quantity of the ammoniacal magnesium chloride, but considerable excess of this reagent often produces but little influence on the result—sometimes none."

Direct Citric Acid Method.

The method of Joulie is employed by some chemists of wide experience. In this process the iron, aluminium, and calcium are all retained in solution by citrate of ammonium, and no attempt is made to separate the calcium as oxalate, but the phosphate is at once precipitated from the ammoniacal solution by "magnesia mixture," the precipitate being either ignited and weighed or dissolved in acetic or nitric acid, and the solution titrated with uranium. This method is in many respects similar to that recommended by Fresenius, Neubauer, and Luck.*

Iron-Acetate Method.

A few chemists employ a process of which the following is an outline:—The neutralised hydrochloric solution of an insoluble phosphate (freed from silica) or the aqueous solution of a soluble phosphate, is treated with acetate of ammonium (filtered from the precipitated phosphates of iron and aluminium if their separate estimation is required), and sufficient ferric chloride added to cause the precipitate to appear distinctly reddish; the liquid is boiled well, filtered, and the precipitate washed slightly. It is re-dissolved on the filter in hydrochloric acid, tartaric or citric acid added judiciously to the solution, and then a tolerable excess of ammonia. The alkaline solution should be greenish, not reddish. "Magnesia mixture" is then added in moderate excess, the liquid stirred, and left over night. The precipitated double phosphate is then filtered off, and treated in the ordinary manner. The method gives results agreeing well with the average of chemists of repute. On repetition the results of the two estimations agree within 0·1 to 0·2 per cent.

Phosphates of Iron and Aluminium.

The precipitate of iron and aluminium phosphates produced by treating the cold solution of a sample containing the above metals with an alkaline acetate (or with ammonia and excess of acetic acid) can be very conveniently analysed by the following method, contributed by Mr. R. Warington. "The precipitated phosphates of iron and aluminium are washed, ignited, and weighed, re-dissolved in strong hydrochloric acid, and the iron determined volumetrically with stannous chloride and iodine (see Fresenius). From the iron the quantity of ferric phosphate in the precipitate is calculated, the phosphate of aluminium found by difference, and thus the iron, aluminium, and phosphoric acid in the precipitate are obtained. A little phosphoric acid is liable to be removed from the precipitate during washing, and basic salts are thus reckoned in the calculation as of normal composition."

Estimation by Uranium.

The removal of iron and aluminium by addition of an alkaline acetate in the cold, with determination of the phosphoric acid in the filtrate by means of uranium,† is a method which appears to deserve more extended employment. The use of an acetate in a slightly acid solution brings the liquid into just the condition required for the use of the uranium method. The volumetric estimation by uranium is very highly spoken of by some chemists as convenient and fairly accurate, while others consider it very unsatisfactory. The conflict of opinion is very great, and special experiments on this process appear desirable, but the following seem to be the precautions necessary for successful working. The proportions of acetic acid and alkaline acetate employed, and the volume of the solution, should be approximately constant. The uranium nitrate should be standarised with an acetic acid solution of pure precipitated ammonio-magnesium phosphate or tricalcic phosphate, instead of with phosphate of sodium, as is commonly done. The titration should be *converse*, the solution of the phosphate being added to that of the uranium. The latter should be mixed with a constant proportion of acetic acid, and heated in a bath of boiling water. The indicator should be powdered potassium ferrocyanide on a white plate. Owing to the reversal of the usual process, the brown colour of the ferrocyanide of uranium becomes gradually fainter till the end of the titration.

This method, which is recommended and employed by some authorities of great experience, is said to be capable of giving results of every desirable accuracy.

The gravimetric method of precipitation by nitrate of uranium is employed by a few chemists, and is very well spoken of.

Molybdic Acid Method.

Of all methods, Sonnenschein's process of precipitation with molybdic acid appears to be regarded the most accurate. All the chemists who refer to it speak of it as extremely accurate, and consider that it is preferable to any other in presence of much iron or aluminium, but comparatively few use it habitually.

The causes of this unpopularity are the time required and the expensive nature of the reagent. As a very large excess of molybdic acid is required above that which is actually precipitated as "phospho-molybdate of ammonium," it becomes an important matter to recover the molybdic acid from the solution. Unfortunately, no very simple process of effecting this appears to have been devised.

The yellow precipitate obtained, containing as it does less than 4 per cent of anhydrous phosphoric acid, becomes very bulky and unmanageable when the weight of phosphoric acid present exceeds 0·1 or 0·2 grm. This fact necessitates the employment of very small quantities of the phosphate; and as the yellow precipitate has to be subsequently re-dissolved and precipitated with magnesia mixture in the ordinary way, the error liable to occur from the use of an unusually small weight of the sample, together with the loss of time and expense incidental to the use of the process, seem to have combined to render the method unpopular for everyday work,* while its value is generally admitted when the above considerations are of little importance.

J. Macagno has recently proposed to reduce the yellow precipitate with zinc and acid, and titrate the solution so obtained with standard permanganate. The test experiments show a maximum error of 0·5 per cent of the phosphoric acid present.

Eggertz's Molybdic Acid Method.

Metallurgical chemists are well aware that M. Eggertz has proposed to weigh the yellow precipitate of "phospho-molybdate of ammonium" instead of re-dissolving it and converting it into ammonio-phosphate of magnesium in the ordinary manner.

This modified plan has the advantage of speed, and the fact that the precipitate contains less than 4 per cent of phosphoric anhydride would render the results extremely accurate.

Unfortunately, it seems improbable that the precipitate

* *Zeits. Anal. Chem.*, ix., 16; and Sutton's "Volumetric Analysis," 2nd edition, page 241.

† It is universally admitted that the estimation by uranium is untrustworthy unless any iron and aluminium present in the original solution is first removed.

* Mr. A. Sibson writes:—"The molybdic acid process is, in my opinion, not suitable for phosphatic minerals, although invaluable for soils, limestones, &c., containing small proportions only of phosphoric acid. The large excess of molybdic acid necessarily employed in the former case is itself a source of error with no adequate advantage, inasmuch as the magnesia precipitate has still to be employed, and it is in the manipulation of this precipitate that the differences in analyses chiefly arise."

has a constant composition, and any sensible variation in the proportion of phosphoric acid contained in it would render it worthless as a method of estimation, at least so far as manures are concerned.

M. Eggertz estimates the anhydrous phosphoric acid contained in the yellow precipitate obtained under the conditions prescribed by him at 3·72 per cent.

Other Methods.

Besides the above-described processes, and trifling modifications of them, descriptions have been received of no other method. The lead, bismuth, and tin processes appear to have fallen into complete disuse. No chemist has reported that he estimates phosphoric acid by precipitating it as tricalcic phosphate by the direct addition of ammonia to the original solution.

(To be continued).

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 164.)

Since lime partially loses its luminous power by continued use, platinum-wire, magnesia, and latterly zirconia, have been employed in its stead.†

The above-mentioned applications of the hydrogen lamps are, however, of a very limited nature. To utilise it on the large scale for street lighting, the simultaneous use of oxygen has been laid aside, and cheaper methods of preparation have been sought for. For this purpose advantage was taken of Felice Fontana's method of decomposing water by means of ignited iron and ignited carbon, as proposed in 1780.‡ On the latter scheme Donovan founded his industrial preparation of hydrogen gas in Dublin in 1830. His process has been repeatedly described with modifications, referring in part to the needful apparatus, and in part to the diminution of the proportion of carbonic oxide. The presence of this poisonous gas was at first justly urged as an argument against the use of the "water gas." Langlois found that the mixture obtained—on allowing steam to pass over iron retorts filled with red-hot coke in Kirkham's apparatus—had the tolerably constant composition of 58 to 60 per cent of hydrogen, 19 to 26 carbonic oxide, and 15 to 20 carbonic acid.

It was subsequently, however, discovered§ that at higher temperatures carbonic oxide is oxidised by watery vapour to carbonic acid, so that if the steam is in excess a gas may be obtained relatively free from carbonic oxide, as shown in the reaction—

$$C+2H_2O=4H+CO_2.$$

In the water-gas prepared at Narbonne, where the gas on issuing from the retorts is conducted through ignited tubes along with fresh quantities of superheated steam, Verver‖ found in 1858, 3·54 per cent of carbonic oxide. According to other observers the amount ranged from 2·5 to 5 per cent. In the water-gas at Passy, Payen found 6 per cent of carbonic oxide, whilst in ordinary coal-gas he found an average of no less than 14 per cent. The above-mentioned objection, therefore, no longer holds good.

The carbonic acid is removed by milk of lime, or, perhaps, more economically, according to the suggestion of Heurtebise¶ by soda, which is thereby converted into bicarbonate, a readily saleable substance.

Fayes* constructed for lighting the town of Narbonne an apparatus which he named gazogen, which furnished in twenty-four hours 1000 to 1200 cubic metres of purified gas, the cost of which, independent of labour, and of the cost and depreciation of plant, he calculates as follows:—

Per 100 Cubic Metres of Gas.

		f.	c.
75 kilometres of coke at 0·03 franc		2	25
55 ,, coal at 0·025 ,, ...		1	37
82 ,, lime			82
		4	44

The material costs, therefore, 4½ centimes per cubic metre.

Instead of decomposing water by carbon, certain other processes have recently come into use, and require notice.

Lenoir's process,† suggested in 1867, is of very limited applicability. He decomposed barium sulphide with water, obtaining sulphate of baryta and hydrogen—

$$BaS+4H_2O=BaSO_4+4H_2.$$

This process is only practicable where the manufacture of barium sulphate (permanent white) is the main object, and the hydrogen a by-product, as was the case with Lenoir.

ON THE MANUFACTURE OF WHITE CAUSTIC SODA.‡

By GEORGE E. DAVIS, F.C.S.

(Continued from p. 166).

In whatever way black-ash may be made it varies but little in its composition; and previous to laying before you some analyses of this substance, I will give the analyses of a few specimens of the raw mixing materials. First salt cake:—

	A.	B.	C.
Insoluble in water ..	0·112	0·073	0·042
Free sulphuric acid ..	0·955	1·820	0·022
Calcium sulphate ..	1·139	1·148	1·046
Iron persulphate	0·682	0·588	0·322
Sodium chloride	2·632	0·234	0·744
,, sulphate	94·393	96·137	97·824
Moisture	0·087	—	—
	100·000	100·000	100·000

A was from a works making moderate salt cake, in what is technically termed a blind-roaster; B from a works making rich cake in an open roaster; while C was a fair sample of salt cake made by Hargreaves's and Robinson's process. The insoluble matter generally consists of silica, clay, and sand, with which is sometimes associated a basic sulphate of iron.

The part played by the free sulphuric acid in the salt cake when in the black-ash furnace is an obscure one; there is no doubt the majority is roasted off and escapes by the chimney; and that the free acid exerts no injurious influence upon the ball I consider proved by the fact that balls have been drawn containing a minimum of sulphate and sulphide from salt cake, containing 2 per cent of free sulphuric acid.

Second, of limestones. Nothing seems to suit a black-ash worker but the Buxton variety; in his ear the word sounds so melodiously that everything is sure to go well if a Buxton wagon is seen in the yard. There is very little in this though, and any moderately pure limestone may be used in the black-ash process. I give a few analyses of lump limestone:—

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."
† See the work of Phillips, quoted above.
‡ *Mem. Soc. Ital.*, xv.
§ Bromeis, *Zeitsch. d. Ver. deutsch. Ing.*, iii. 82, and *Dingler Polyt. J.*, clxiv. 33, 1859
‖ B. Verver. "L'éclairage au gas à l'eau à Narbonne et l'éclairage au gaz Leprince." Leiden, 1858. See Bromeis, *opus citat.*
¶ Heurtebise, *Dingl. Pol. J.*, cxxcvi. (?), 393, 1867.

* Fayes, *Génie industriel*, 1868, 329. *Dingl. Pol. J.*, clix. 47.
† Lenoir, *Wagn. Jahresber.*, 1867, 219, 259.
‡ From the *Journal of the Society for the Promotion of Scientific Industry.*

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	Buxton.	Minera.	Ruthin.
Organic matter	traces	traces	traces
Silica	0·106	0·442	0·398
Alumina	0·123	0·145	0·135
Ferrous carbonate ..	0·187	0·348	0·252
Calcium	99·372	98·298	98·370
Magnesium	0·116	0·756	0·756
Manganese	0·013	0·022	0·026
Calcium phosphate ..	trace	trace	trace
	99·917	100·011	99·937

All of these limestones make excellent black-ash; but it must not be supposed that the crushed limestone supplied to a works is of a purity equal to the above. The analyses are merely given to show the nature and amount of the various constituents other than calcium carbonate, for as used in the black-ash mixing there is invariably present a quantity of clay, sand, and other foreign matters, which largely increase the amounts of silica, alumina, and iron.

The analyses of lime, mud, and of the fished salts will be found further on in other sections.

Lastly, of the mixing slack. It is this constituent of the black-ash mixing which introduces so many objectionable matters into the black-ash ball. This is too often lost sight of, and chemists go rambling over an estimation of the sulphur, a perfectly useless operation, and forget the constituents of the ash. The ashes of slacks vary but very little, and often introduce into the black-ash ball very large amounts of silica, alumina, and iron. The ashes left from different coals have been examined often, and some analyses may be seen in Phillips's "Elements of Metallurgy."

The ashes of slack used in mixing vary a little from the coals; as an example of this I give the following analyses:—

	A.	B.
Silica	49·36	48·74
Alumina	26·86	22·79
Iron peroxide	14·00	18·76
Lime	7·07	5·43
Magnesia	0·48	0·99
Sulphuric acid (SO_3)	1·12	2·74
Phosphoric ,, (P_2O_5)	0·11	0·05
	99·00	99·50

Mixing slack is generally examined for its percentage of ash and sulphur. The former is all important, and generally varies from 7 to 16 per cent, a good sample containing, however, not more than 10 per cent. As to the percentage of sulphur, without it is very large, it may be safely neglected.

Up to 1·5 per cent I have proved that it exerts no injurious action upon the black-ash.

A slack which was producing very good results in the black-ash mixings was examined as follows:—

	Per cent.
Sulphur	1·432
Ashes	10·000
Carbon	70·122
Nitrogen	0·286
Combustible matter	88·590
Volatile sulphur	1·387
Silica	4·936
Alumina	2·575
Iron peroxide	1·511
Lime	0·700
Magnesia	0·052
Sulphuric acid (SO_3)	0·243
Phosphoric ,, (P_2O_5)	0·006
	100·000

As I have before mentioned the slack is generally examined for its ash and sulphur, also for its moisture in some places. The following are a few analyses of mixing slacks made in this way:—

	Ash.	Sulphur.	Moisture.
1.	4·46	0·724	2·41
2.	5·77	0·986	1·00
3.	7·41	0·937	10·14
4.	10·84	1·116	4·72
5.	10·96	1·736	5·11
6.	13·42	0·543	2·98
7.	16·76	0·431	1·22
8.	28·96	1·774	3·44

The nitrogen in the slack is also an injurious constituent. Under the influence of the heated lime and alkali, some of it escapes in the form of ammonia, which, uniting with the free sulphurous and sulphuric acids of the furnace atmosphere, passes away from the chimney in white clouds of sulphate of ammonia mixed with a little cyanide of ammonium. A great deal of ammonia also escapes when the ball is being drawn from the furnace, and even until the ball has cooled very considerably. Another portion of the nitrogen is converted into sodium sulphocyanide, while the remainder goes to form cyanide, from which ferrocyanide is formed in the lixiviating process. It may be worthy of remark here that a well fired ball containing a moderate excess of limestone generally contains less cyanide than one which has been drawn short of fire.

The following analyses from Phillips's "Metallurgy" will give some idea of the amounts of nitrogen present in different coals. Slacks contain less in consequence of the dilution occasioned by the presence of a large quantity of ashes:—

Description.	Locality.	Per cent Nitrogen.
Bedwas	North Wales	1·44
Hills, Plymouth works	North Wales	0·46
Haswell, Wallsend	Newcastle	1·42
West Hartley Main	Newcastle	1·69
Staveley	Derbyshire	1·23
Haydock, Little Delf	Lancashire	0·54
Ince Hall Co.'s, Arley	Lancashire	1·76

The ball compounded as before described is pitched or dropped into the black-ash furnace, gradually heated and fluxed, being drawn into an iron bogie, when the jets of inflamed carbonic oxide are commencing to diminish in number and intensity. When drawn, however, from the furnace the reaction is not complete, the action continuing until the ball has set and become thoroughly solidified. As an instance of this I give the following analyses, each experiment being made upon the work of six furnaces for a single shift—or, in other words, each experiment is the average of seventy-two balls:—

	Total soda.	Sodium sulphate.	Sodium sulphide.
1. Sample taken when drawing balls ..	26·00	2·4	0·21
2. Sample taken from ball bank (cold) ..	27·00	1·2	0·29
3. Sample taken when drawing	21·00	3·5	0·14
4. Sample taken from ball bank (cold) ..	21·00	1·7	0·14

The time the ball is exposed to the action of heat will, of course, vary with the number drawn per shift. In one works, drawing twenty stone balls with lime mud in the mixing, twelve balls are worked and drawn between the hours of six a.m. and four p.m., whilst in another works it is stated that sixteen of the same balls are drawn between six a.m. and five p.m., and in one firm where twenty-four stone balls are worked, twelve balls are worked and drawn at the same time. The theory of the process I have always adopted, and which seems to be the most correct, is that of Mr. Gossage. It may be expressed in equations thus:—

$$2Na_2SO_4+3CaCO_3+9C=2Na_2CO_3+2CaS+CaO+10CO.$$

The proportions of the ingredients used agree very well with the formula in every detail, and when some manufacturers employ an excess of limestone and slack, it is

only for the purpose of mechanically aiding (so to speak) the decomposition, and also for obtaining a large quantity of sodium hydrate in their liquors.

I now give the analysis of some black-ash balls made from the following mixings:—

	A. cwts.	B. cwts.	C.
Salt cake, 96 per cent ..	2·50	2·50	Supposed to be the same as A.
Buxton limestone	2·75	1·50	
Lime mud (Buxton) ..	—	2·50	
Slack	1·50	1·50	
Fished salts	—	14lbs.	

A and B are both good balls, but C is what is technically known as a red or burnt ball, which results from an excess of salt cake and slack in the mixing, or a deficiency of limestone.

The difference between them may be seen in the analysis.

The true composition of the ball, as has been clearly set forth by Kynaston, Muspratt, and others, is undoubtedly a mixture of carbonate of soda, with calcium, sulphide, and oxide, containing also a little carbonate; still, I have calculated the analysis into what is actually soluble and insoluble, so that it may be readily seen what is obtainable as vat liquor, and what portion is left behind as the waste.

	A.	B.	C.
Sodium carbonate ..	28·144	31·807	28·336
,, oxide	5·860	5·614	3·844
,, chloride	2·808	2·574	3·101
,, sulphate	0·192	0·190	3·037
,, sulphite	0·151	0·072	none
,, hyposulphite ..	0·189	0·853	0·126
,, sulphide	0·358	0·163	6·645
,, aluminate ..	0·344	0·752	0·923
,, silicate	1·026	0·914	0·758
,, cyanide	0·186	0·043	0·422
,, sulphocyanide	0·074	0·021	0·077
Calcium sulphide ..	29·504	28·744	33·245
,, carbonate ..	12·657	9·272	6·087
,, oxide	10·048	9·488	3·465
Iron sulphide	0·554	0·774	1·355
Alumina	0·172	1·042	0·624
Silica	1·095	0·923	0·973
Magnesia	0·266	0·322	0·146
Soda	0·344	0·546	0·577
Carbon	4·263	4·483	4·958
Sand	1·237	0·875	0·842
	99·472	99·479	99·646
Soluble iron sulphide ..			0·105

The injurious action of the silica and alumina in the mixing materials may be seen in the analyses. Silicate and aluminate of soda are formed, which are soluble, while a double silicate of alumina and soda is left in the black-ash waste insoluble; a manufacturer should, therefore interest himsef in keeping his mixing materials as free as possible from these injurious substances. The silicate and aluminate of soda in solution also react upon each other, even at a temperature of 120° F. producing this insoluble double silicate.

This black-ash process should be scientifically overlooked, daily if possible; it is a chemical process, and should be placed under strict chemical superintendence.

The black-ash balls should be carefully sampled from the ball bank, and the results entered in a book in the following form:—

Date.	Description.	Total Na_2O.	Total sulphur as Na_2SO_4.	Na_2S.	NaCl.
Dec. 16.	Night work—No limestone ..	22·94	2·01	0·146	4·09
Jan. 6.	Day's work—No salts	19·97	2·72	0·179	1·87
Feb. 4.	No. 4 furnace—A fresh hand ..	24·16	3·04	0·244	4·00
Mar. 8.	Day's work ..	22·26	1·25	0·098	2·29

Results such as these, when accurately kept, form valuable numbers for comparison.

(To be continued.)

THE ATOMIC WEIGHT OF THE CERIUM METALS.

By S. E. PHILLIPS.

Some time ago I prepared some short laboratory papers on the least known elements, such as glucinum, lanthanum, and others; meanwhile a great interest has been evinced on the subject, and long lists of these combinations have appeared in recent numbers of the *Journal of the Chemical Society*.

In regard to these, there are three alternatives:—(1) The old, the essentially chemical point of view, which regards them as weakly basic and monatomic; (2) that which regards them as di-atomic, of which several lists have been given by men of great eminence; and (3) the triatomic point of view, which is the most recent.

We now propose to condense our remarks into one paper on the group cerium, erbium, lanthanum, didymium, glucinum, and indium, such congeners having many close, chemical, and even isomorphous relations.

The great differences of opinion as to the atomic values of the chemical alphabet prompt the enquiry as to what can be done in the way of placing the matter before some crucial standpoint, so as to promote a more unanimous settlement.

Time was when the old chemists fought valiantly for the faith, but all martial energy seems to have died out, with the ignoble defeat of the illustrious Swede.

A short time ago, an anonymous trumpet blew a threatening blast from Burlington House, which took immediate effect, in so far that the *Journal of the Chemical Society* ceased to mutilate the notations of M. Berthelot and other eminent chemists; but, as a rule, these great men are content to see, with quiet satisfaction, that every accession of new knowledge adds force and clearness to the older atomic weights.

It seems to me a cardinal point with many to consider the elements as blank units which may be played with numerically; they coldly and grudgingly accept the Daltonic proportions, and seem to consider it immaterial whether an element be xCl, x_2Cl_2, or x_3Cl_3, excepting so far as volume or specific heat may determine.

On the contrary, we maintain that electro considerations are all paramount, and that, if any element be di- or tri-atomic in relation to O or Cl, it will evince this negative quality in the negative or acid character of its typical combinations; and, conversely, that if monatomic, it must necessarily evince a combining portrait of basic features.

Mercury, platinum, and gold may be found as proto-oxides or chlorides; but they are typically, or most naturally, either bi or tri, and their consequent negative or acid behaviour is plainly evinced in every portrait, by whomsoever drawn.

We have strongly urged these considerations in regard to the metal indium (Chemical News, vol. xxvi., p. 2), and they are as fully paramount in relation to the cerium group generally, where the predominant basic features plainly indicate their proto-electro characters.

Why, indeed, should the tribasic succinates or tartrates, the monobasic acetates, the tribasic cyan-ferrates or cobaltates, the proto-cyan-platinates, and others, so exactly agree with the well-known corresponding types of sodium and potassium.

Well indeed may Professor Wanklyn protest that many diatomics were doubled on very insufficient evidence; and Watts, in his esteemed "Dictionary" (p. 226), states that "in anorthite and other minerals, when alkali metals are replaced isomorphously by calcium, that such replacement takes place in equivalent proportions, *e.g.*, 39 parts of K by 20 of Ca."

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How intensely hypothetic is the notion of polyatomic properties *per se* will be fully seen by any fair appreciation of the purely *relative* character of chemical affinity.

Let us compare in this way O and S with their two bonds, hooks, or points of attachment; with Cl or H, which have only one.

Antithesis of electro-property is the universal bond of strongest uniting force, producing in chemistry the simplest types and the most definite chemical characters; hence the remote unions of Cl or S are similarly proto in character, and the double oxides, chlorides, or sulphides all evince the same general distinguishing peculiarities. One representation will suffice for either:—

MgS + HS
CaS + HS
SiS + HS
LiS + HS
BaS + HS
NaS + HS
KS + HS
AmS + HS

These are definite crystalline salts, and have many characters in common. The lowest three bear a red heat without decomposition, and several of the others stand a very high temperature, while the Mg salt exists only in solution.

The simple types and great strength of character of the alkaline oxides, chlorides, or sulphides are too well known to require emphasis, and therefore it is we call attention to the same law among salts. Ascending the scale above magnesium, we pass intermediate sesqui and other varied ratios, and find an opposite region of simplest type, where H has an inverted position.

As the *negative* remoteness of H gives strength and simplicity to the alkaline oxyhydrates or sulphydrates, so the *positive* remoteness of H in relation to the higher acids, gives another strength and mono simplicity, as in the sulphates, manganates, aurates, &c.

$$HO + SO_3.$$
$$MO + MnO_3.$$
$$MCy + AuCy_3.$$
$$MCl + AuCl_3, \&c.$$

The intermediate types being normally di-, tri-, or sesqui-basic, with a tendency to an endless variety of complex ratios. Some of the most normal intermediate types are:—

$$2MCy + FeCy.$$
$$3MO + Fe_2O_3.$$
$$3MCy + CO_2Cy_3.$$
$$2mCy + Pt_3Cy_4.$$
$$2MCy + Pt_4Cy_5, \&c.$$

Of course, this law of typical progression can be more simply estimated in the elementary series, as compared with the + or alkaline extremity on one side, and the negative or chlorous on the other.

1 to 7–1 to 5.	1 to 3.	1 to 2½.	1 to 2.	1 to 1½.	1 to 1.
$-ClO_7$.	$BiCl_3$.	W_2O_5.	$HgCl_2$.	Al_2O_3.	FeO.
ClO_5.	SO_3.	S_2O_5.	SnO_2.	Fe_2Cl_3.	BaCl.
NO_5.	$AuCl_3$.		$PtCy_2$.	Co_2Cy_3.	NaO.
PO_5.	$MnCy_3$.		SiO_2.		KCy, &c. +
AsO_5.			CS_2.		

A non-recognition of these simple facts, and the universal law they exemplify, has overlaid a beautiful science with conflicting hypotheses of atomicities, quantivalences, &c., and some way out of the chaos seems anticipated, if not prayed for by all.

Confused conceptions can never lead to a clear and simple nomenclature; the atomic weight of aluminium is first of all doubled, and then, to make it "a tetrad of even atomicity," it is again doubled, so that the chloride may have its atomicity thus pourtrayed:—

$$Al'''\equiv Cl_3.$$
$$|$$
$$Al'''\equiv Cl_3.$$

This ingenious device satisfies the four hooks or points of attachment; and the rising generation of chemists receive such intellectual pabulum, and are satisfied.

Accustomed to such barbarous terms as hydrochloric acid, &c., and taught to despise the indications of electro-law, the student sees no incongruity in a hydrate of alumina, $3HO + Al_2O_3$.

Like H, Al has a midway position, and may be either chlorous or basylous. We may have a sulphate of −Al, because it is basic, or + to the higher or more − acids; but it is chlorous, or more −, to H and the earthy and alkaline metals, and hence the minerals—

Spinelle as an aluminate of Mg, $MgO + Al_2O_3$.
Diaspore " " " H, $2HO + Al_2O_3$.
Or the artificial " " H, $3HO + Al_2O_3$.
And the chlor-aluminate of Na, $3NaCl + Al_2Cl_3$.

As in biology some species are tenaciously proud of caste, and hold their position with a haughty exclusiveness, while others flirt to various changes of relative position, so in minerals the same peculiarities subsist.

Clever, indeed, would be the chemist who could persuade aluminium to depart in any way from its select sesqui position, while manganese may be found among the proto bases, and through intermediate stages up to the higher acid types.

Glucinum is a little-known element of great interest, as being the lightest of all metals, with a weight less than five-fold that of hydrogen.

	Mono.	Di.	Tri.
Glucinum	4·70	9·40	—
Yttrium	29·85	58·70	88·5
Indium	37·80	75·60	113·4
Cerium	46·00	92·00	138·0
Lanthanum ..	46·38	92·76	139·0
Didymium ..	47·92	96·00	144·0
Erbium	56·85	113·70	170·5

P. T. Cleve suggests that Ce, Di, La, Er, and Y form one group of triatomic elements, that Ce and La are an isomorphous sub-group and Y and Er another, and Di intermediate with affinities to both.

Marignac, from a diatomic point of view, notates the chloro-platinates of Ce, La, and Di as isomorphous, also the nitrates of La and Di, that phenakite and willenite are isomorphous silicates—

$2GlO + SiO_2$. $2ZnO + SiO_2$.

Rammelsberg considers the erbium salts mostly contain the same HO as the zinc and Mg salts, and that the sulphate is isomorphous with cadmium sulphate.

Combinations of the Cerium Group.

Ides,	MO.	
"	MCl.	
"	MS.	
"	MCy.	
Some,	M_2O_3.	
"	M_2Cl_3.	
Chlorates,	MO	$+ClO_7$.
"	MO	$+ClO_5$.
Iodates,	MO	$+IO_5$.
Nitrates,	MO	$+NO_5$.
Ortho-phosphates,	3MO	$+PO_5$.
Pyro-phosphates,	2MO	$+PO_5$.
Meta-phosphates,	MO	$+PO_5$.
Sulphates,	MO	$+SO_3$.
Sulphites,	MO	$+SO_2$.
Selenates,	MO	$+SeO_3$.
Selenites,	MO	$+SeO_2$.
Acetates,	MO	$+(C_4H_3O_2)O$.
Formates,	MO	$+C_2H_1O_2,O$.
Carbonates,	MO	$+CO_2$.
Oxalates,	MO	$+CO,O$.
Silicates,	2MO	$+SiO_2$.
Succinates,	2MO,HO	$+C_8H_3O_4,O$.
Tartrates,	2MO,HO	$+C_8H_3O_8,O$.
Chloro-platinates,	MCl	$+PtCl_2$.
" "	MCl	$+PtCl$.
Cyano-platinates,	MCy	$+PtCy$.
Cyano-ferrates,	2MCy	$+FeCy$.
" "	3MCy	$+Fe_2Cy_3$.
Cyano-cobaltates,	3MCy	$+Co_2Cy_3$.
Sulpho-cyanates,	MS	$+CyS$ or $(CS)_2MN$.

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Double Salts.

Sulpho-cerates, KO,SO_3+CeO,SO_3.
Sulpho-glucinates, $KO,SO_3+GlO+SO_3$.
Other types, KO,SO_3+3CeO,SO_3.
" " KO,SO_3+3YO,SO_3.
Carbo-cerates, KO,CO_2+3CeO,CO_2, &c.

The work of translating these mono equivalents out of the curiously-contrived confusion of di- and tri-atomic types has been a task of severe labour. M. Cleve's pyrophosphate of $Di=Di'''_4(P_2O_7)_3$; therefore, by multiplying—

$$\left.\begin{array}{l} Di\times3\times4 = 12 \\ P\times2\times3 = 6 \\ O\times2\times7\times3=42 \end{array}\right\} = 6\,(2DiO+PO_5).$$

M. Jolly's pyrophosphate of Ce is—

$$HCe'''P_2O_7=3CeO,HO+2PO_5.$$

His ortho-phosphate—

$$Ce'''(PO_4)=3CeO+PO_5.$$

Atterberg's chloro-platinate of Gl =

$$=BePtCl_6=2(BeCl+PtCl_2).$$

There is a symmetry in my acetates, formates, and oxalates, but what may we say of M. Jolly's?

Acetate of cerium—

$$2(C_2H_3O_2)_3Ce'''+3H_2O=6(CeO+(C_4H_3O_2)O-HO).$$

Formiate—

$$(CO_2H)_3Ce''=3(CeO+(C_2H_1O_2)O).$$

Oxalate—

$$(C_2O_4)_3Ce_2+9H_2O=6(CeO+C_2O_3-3HO).$$

Among cyano-salts, my platinates, ferrates, and cobaltates have strictly normal types, such as abound with earthy and alkaline metals, but they are derived from a curious assemblage.

M. Jolly's cyan-ferrate =

$$=Ce_2Cy_2Fe_2+8H_2O=2(3CeCy+Fe_2Cy_3).$$

Like the well-known red prussiate—

$$3KCy+Fe_2Cy_3.$$

There is also a yttrium analogue—

$$3YCy+Co_2Cy_3.$$

The following equivalents are not at all easily seen, but will be found to be correct. Atterberg's sulphite and selenites are thus:—

$$GlSO_3.GlO_2H_2+2H_2O=2(2GlO+SO_2-3HO).$$
$$2(2GlO+SeO_2-3HO).$$

He has two sulphates—

$$GlO+SO_3-4HO.$$
$$2GlO+SO_3-2HO.$$

And a pyrophosphate—

$$2GlO+PO_5.$$

It is still more difficult to find the meaning of the double salts, nor is it scarcely worth the prolonged effort; for with weak generic forces of combination it is easy to imagine crystalline forms of very varied ratios, as dependent on temperature, the strength of solutions, &c. M. Jolly gives a double sulphate of Ce and K—

$$(SO_4)_3Ce_2+3(SO_4)K_2=6(KO,SO_3+CeO,SO_3).$$

And a corresponding selenate—

$$6(KO,SO_3+CeO,SO_3).$$

Also another type of both these acids—

$$(SO_4)_3Ce_2+(SO_4)Na_2=2(NaO,SO_3+3CeO,SO_3).$$
$$2(NaO,SeO_3+3CeO,SeO_3).$$

His carbo-cerate is—

$$(CO_3)_3Ce_2+(CO_3)K_2=2(KO,CO_2+3CeO,CO_2).$$

The laboratory part of this paper consists in urging that these atomicities are capable of clear and immediate settlement.

As an angel from heaven is admittedly incapable of impressing belief on those who will not see, I am far from supposing that all may be convinced; but, to very many, the following amount of evidence may be deemed fairly conclusive:—

(1). Let it be shown that the mono weights are those which are eliminated in the electrolytic circuit, in relation to H 1 or Ag 108.

(2). Let it be shown that the mono weights are those which replace one H, or equivalent radical, in ammonia or other substitutional body.

The sulphocyanates already obtained will be, in the judgment of many, sufficiently conclusive; as Hofmann's phenyl-sulphocyanate is $(CS)_2(C_{12}H_5)N$, so a cerium-sulphocyanate would be $(CS)_2CeN$, and similarly with most of the others already obtained. The admission that we may have sulphocyanates which are not true ammonias in no respect alters the strength of the argument that, whatever may be the type, ethyl, cerium, or yttrium stand in the place of, and are equivalent to, one H.

It may be well, however, to look for other ammoniacal forms, such as—

Potassium amide, H_2KN.
Cerium " H_2CeN, &c.

We might have a fuller development of the simpler double saltic types, and why not a cerium or glucinum alum?

M. Rœssler has chivalrously taken the field in this direction, but, after looking far and wide, I in vain look for his atomic weight.

"The specific heat of indium requires its equivalent to be 113·4, and leads us to ascribe to its oxide the formula In_2O_3. Hitherto, this view has been unsupported by facts, but M. Rœssler has succeeded in obtaining the alum of indium and ammonium, $In'''_2(SO_4)_3NH_4SO_4+24H_2O$." —(CHEMICAL NEWS, vol. xxviii., p. 227.) Here we have a complex assemblage of mono-, di-, and tri-atomic elements, still further confused by clerical error (such being the most charitable interpretation). I therefore challenge the entire result?

We have thousands upon thousands bequeathed and otherwise devoted to the prosecution of original research; and, while these munificent appropriations are the outcome of a wide bewailment of English backwardness in this direction, while we have public laboratories, collegiate and other classes, devoted to practical demonstration and research, is there no one spot in this enlightened country where we may hopefully look for a solution so simple and so pregnant as some of the points here desiderated?

Cerium and some of the other analogues have a decided tendency to the sesqui type, and an alum may certainly be looked for as an easy triumph.

NOTICES OF BOOKS.

*Notes on the Detection of Dye Drugs Used for Colouring Wines.** By Dr. R. STIERLIN, of Luzern. Leipzic: J. A. Barth.

"AMONGST all articles of diet none are so much exposed to adulteration as wines, especially red wines. The manufacture of red wine, for so we may call it, has been created on the one hand by the exorbitant duties which certain governments and municipal authorities levy upon wine, and on the other by the desire to accumulate wealth in a short time with a minimum outlay of labour and capital. That there are people who offer in return for certain fees to impart full instructions how to prepare wine without 'grapes,' and who term themselves 'chemists,' can be learnt from the advertising columns of Swiss and German papers. That the investigation of red wines must form an important part of food analysis is easily to be seen. Much has been already written by chemists on the detection of the adulterations of red wines, and many of the instructions do not say how much of the reagents should be employed. Consequently discordant results must be obtained according to the proportions used."

The author takes a certain amount of wine, *e.g.* 250 c.c., and adds to it basic acetate of lead as long as

* "Notizen über Erkennung der Farbstoffe welche zum Färben des Wein es benutzt werden."

a precipitate is produced. This is collected upon a filter, repeatedly washed with distilled water and dried at 100° C. It is then ground up to a not very fine powder and introduced into a glass tube drawn out below to a point with a small aperture and plugged with cotton. About 25 c.c. of ether, previously saturated with hydrochloric acid, are then poured over it, and after it is drained off the operation is repeated with the same quantity of hydrochlorised ether. It is desirable that the ether may percolate slowly in order that the oxide of lead combined with the colouring matter of the wine (so-called œnolin, $C_{20}H_{10}$) may be perfectly converted into lead chloride. The precipitate is then repeatedly washed with pure ether, in which the colouring matter is insoluble, in order to remove the excess of hydrochloric acid. For this purpose six applications of 10 c.c. each are generally sufficient. The tube is then dried in the air-bath, a current of air being preferably drawn through it from the mouth to the point by means of an aspirator. When dry the tube is fixed air-tight into a flask, and the upper or wide end is fitted with a perforated cork and a rather long bent tube, forming a so-called Anthon's extractor, in which 50 c.c. of alcohol at 36° by repeated distillation and reflux withdraws all the red vinous pigment from the lead precipitate. In all genuine wines this lead precipitate becomes a pale flesh-colour after the third treatment, and white by the fourth or fifth, whilst the alcohol takes a fine red colour. If the 50 c.c. of alcohol are now made up to 250 c.c. with distilled water the colouring matter is in its original state of dilution. This solution is not very stable, and deposits reddish-brown flakes after standing twelve to twenty-four hours. The alcoholic solution is very permanent. This colouring matter was then submitted to the action of certain reagents in comparison with the following colouring matters, boiled in white wine:— logwood, peach-wood, papaver rhœas, hollyhock, cochineal, litmus, magenta, carrot-juice, and with the fermented juices of bilberries, cherries, and elder-berries. Each of these liquids were then tested both alone, and mixed with 70 per cent. of genuine red wine. The reagents employed were:— 2 c.c. ammonia at 10 per cent, with 0·5 c.c. sulphide ammonium to 25 c.c. of the sample. After filtration the liquid was made up to 100 c.c. with distilled water. The colour of the precipitate, if any, was judged on the filter. Second. 2·0 (grms.?) manganese peroxide to same quantity; the whole shaken and filtered after ten minutes. Third. 25 c.c. solution bicarbonate of soda containing one-twelfth of dry material. Quantity of sample the same, and the filtrate made up with distilled water to 250 c.c. Fourth. 2·5 c.c. pure concentrated nitric acid and to 25 c.c. sample; heated in the water-bath for ten minutes to 85° to 90°. Fifth. 0·625 (grms.?) peroxide of barium and 25 c.c. of sample; allowed to stand for twenty-four hours with occasional shaking, and filtered. Sixth. 5 (grms. ?) zinc; 2 c.c. concentrated sulphuric acid; 25 c.c. of the sample; filtered after twenty hours. Seventh. 100 c.c. solution of alum (8 per cent.), 100 c.c. of sample and precipitate, with 100 c.c. of solution of carbonate of ammonia at 10 per cent; the colour of the precipitate is examined on the filter, moist. Eighth. Basic acetate of lead added to 250 c.c. of the sample as long as a precipitate is produced. The colours of the precipitates are examined when dry, when treated with hydrochlorised ether; the colour of the ether, the colour of the residue dissolved in 30 c.c. of water by the acid of excess of ammonia; the colour of the lead precipitate after treatment with 50 c.c. of alcohol at 36°; colour of 10 c.c. of the alcoholic extract with ½ c.c. and 1 c.c. of ammonia, and the colour of one-half of the extracted lead precipitate treated respectively with ½ c.c. ammonia, and extracted with 10 c.c. water, containing 2 per cent. hydrochloric acid, and the red extract mixed with 3 c.c. ammonia.

We regret that space does not allow us to insert the valuable tables of the colours produced by all these operations.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 11, September 13, 1875.

Fatty Matter of the Seed of the Chinese Oil-Tree.—M. S. Cloëz.—*Elæococca vernicia*, the oil-tree of China and Cochin China, is a plant of the family of the Euphorbiaceæ. Its seeds, when submitted to strong pressure in the cold, yield about 35 per cent of a liquid oil, colourless, inodorous, and almost insipid. Its specific gravity at 15° is 0·9362. At −18° it thickens without losing its transparency or crystallising. By treatment with ether 41 per cent of oil can be extracted from the seed, slightly coloured, but presenting otherwise all the characters of the oil obtained by pressure. If instead of ether purified bisulphide of carbon is employed, the fatty matter remaining after the solvent has been evaporated off at 100° solidifies on cooling, forming a number of small reniform masses, which present under the lens a decided crystalline texture. This solidified fat has the same elementary composition as the liquid oil obtained by pressure, and melts at 34°. The oil extracted by pressure in the cold is rapidly solidified by light in the absence of air, an effect which, on further experiment, was found due to the more refrangible rays of the spectrum alone. The oil of *Elæococca* is the most drying of all oils. If spread on a plate of glass or metal it dries in a few hours on exposure to the air.

Certain Reactions of Hæmoglobin and its Derivatives.—M. C. Husson.—Hæmoglobin on absorbing iodine splits up into hæmatin and globulin. This fact is proved by the spectral analysis, which gives between C and D the absorption-ray of hæmatin, which does not seem to be affected by the iodine. Chautard has already shown that this element has no influence upon the rays of chlorophyll. The microscope also indicates the splitting up of hæmoglobin. With bromide of potassium we obtain crystals of hydro-bromate of hæmatin, of a rosy tint. On treating blood with borax and glacial acetic acid we obtain all the crystals described by MM. Robin and Verdeil in their "Traité de Chimie Anatomique" under the name of hematoidin. Glacial acetic acid alone gives, without the aid of any other reagent, fine crystals of acetate of hemine.

No. 12, September 20, 1875.

With the exception of an article on the discovery of gallium, particulars of which appeared in the Chemical News for October 1, this issue contains neither chemical nor physical matter.

Moniteur Scientifique, du Dr. Quesneville, September, 1875.

Researches on the Gastric Juice.—Richard Maly.—Already noticed.

Contributions to the Knowledge of Alizarin and of Oxyanthraquinon.—Conrad Willgerodt.—Already noticed.

Antiseptic Action of Salicylic Acid.—C. Neubauer.—The author considers that salicylic acid will be of great value in the preservation of wines, but that it is rather adapted to prevent, than to cure, morbid changes in this liquid. He mentions that a wine merchant had bought a hydrometer in the expectation that it would show him the quantity of acid in his must!

New Communications on the Effects of Salicylic Acid.—M. H. Kolbe.

Salicylic Acid in Veterinary Practice.—Dr.

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Action of Salicylic Acid as a Medicament.—Dr. Fontheim.—Important papers on the medical applications of salicylic acid, especially in the treatment of diphtheria.

Action of Organic Acids and their Anhydrides upon the Natural Alkaloids.—G. H. Beckett and C. R. A. Wright.—From the *Journal of the Chemical Society*.

Dilatation and the Specific Heat of Alloys and their Relations with the Law of Dulong and Petit.—M. W. Spring.—Two powerful motives originating in modern scientific theories have led physicists to admit that the law of Dulong and Petit on the capacity of the atoms of simple bodies for heat is the expression of a truth. The numerous and delicate experimental verifications to which it has been submitted by distinguished physicists, have shown that it admits of a great number of exceptions, and that a rigorous experimental proof is still wanting. This need not surprise us, for the magnitude measured under the name of specific heat is composed of two factors—the *thermic capacity*, *i.e.*, the quantity indicating the increase of the *vis viva* of molecular movements, and of a quantity which vanishes for the thermometer and is employed to overcome the interior resistance, or to effect the work of disaggregation. The author has determined the expansion and the specific heat of four alloys, those of Rose, $Bi_7Sn_6Pb_4$, of Darcet, $Bi_{13}Sn_{10}Pb_3$, of Lipowitz, $Bi_{11}Pb_6Sn_5Cd_4$, and of Wood, $Bi_4PbCd_2Sn_2$. Each of these alloys was found to have a point of maximum density. On determining the specific heats of the same alloys, he found that the variations of specific heat follow the variations of volume independently of temperature.

French Perfumery at the Exhibition of Vienna.—This subject will be noticed in due course.

Concentrated Beer.—From the *Standard*.

French Association for the Advancement of Science.—The fourth annual meeting took place at Nantes, on August 19.

Certain Colouring Matters Derived from Aniline.—M. Ch. Lauth.—Reserved for insertion in full.

Varieties in Analytical Chemistry.—M. Neubauer.—These varieties consist of a notice of Landolt's method of determining the molecular weight according to the vapour volume; a short paper on the formation of urea in the bodies of animals; a process for detecting the presence of water in ethereal oils; a note on the detection of bile by Pettenkofer's method; a paper on the determination of uric acid; a notice on the use of chloroform to separate vegetable poisons in chemico-legal investigations; a process for isolating and detecting strychnine in poisoning cases, and researches on the detection of arsenic in the air of rooms.

Archives Néerlandaises des Sciences Exactes et Naturelles.
Tome x., 1me livraison, 1875.

Albuminous Compounds of the Blood-Serum and of White of Egg.—A. Heynsius.—Not suitable for abstraction.

Quantitative Determination of Albumen in Animal Fluids.—A. Heynsius.—For the detection of albumen in animal fluids, especially in urine, the author proposed, in 1870, to add acetic acid until the appearance of a distinctly acid reaction, to mix with the liquid then a few c.c. of a concentrated solution of chloride of sodium, and to boil. This method he still regards as the best and safest, pointing out that the use of nitric acid is objectionable for two reasons: that a reaction may be obtained which simulates the presence of albumen when it is really absent, and that in other cases the behaviour of the mixture may cause its absence to be assumed when really present. For the quantitative determination of albumen, however, the acetic acid and chloride of sodium process cannot be employed. After passing in review the various known methods, the author recommends the following process:—He commences by separating, by means of dialysis with distilled water the greater part of the salts and all the other crystalloid substances, an operation in which merely a trace of albumenoid passes the parchment-paper. The dialysed liquid, the volume of which must have been determined before dialysis, is then made up to ten times its original measure: 50 c.c. are then taken, and the total solids therein contained are determined. From the figure thus obtained 2 per cent is deducted for alkali, when the remainder shows the amount of albumen.

Determination of Urea in the Blood and in the Tissues.—C. A. Pekelharing.—The author, after an examination of the various known methods, concludes that the determinations of urea in the blood and the tissues hitherto executed merit but a limited confidence; the direct determinations because the nitrate and oxalate of urea are not absolutely insoluble in nitric and oxalic acids, even when concentrated; and the indirect analyses because the products of decomposition wnich serve for the determination are not characteristic of urea, but may likewise be yielded by other substances. Hence the theories on the origin of urea founded on such determinations are doubtful.

Tome x., 2me livraison, 1875.

Reaction of Chloride of Sulphur with Aniline.—J. A. R. Smit.—The author states that this reaction has been already studied by Claus and Kral (*Deutsche Ber.*, 1871, 99), but that these experimentalists obtained abnormal results, because the diluent agent which they employed interfered with the reaction. M. Smit mixed chloride of sulphur and aniline undiluted, and observed the formation of the violet matter described by Claus and Kral, along with brown vapours. He then employed anhydrous ether to moderate the reaction. When the process was at an end the filtered liquid was distilled in the water-bath to expel ether, and then heated in a retort over the naked flame. Between 180° and 183° the thermometer remained constant, and a little aniline passed over. The temperature stopped for a short time between 220° and 230°, and a yellow oil, of a disagreeable odour, distilled over. After this the thermometer rose abruptly to 250°? 280°, at which temperature the mass in the retort became completely carbonised. Vapours still passed over, and condensed in the receiver. The last products, distilling between 220° and 280°, were collected together. After a short time crystals were deposited, consisting of two species, evidently distinct. The one kind were white, silky needles, soluble in ether and alcohol, and fusible at 103°. The others form clear yellow prisms, insoluble in water, but soluble in alcohol.

MISCELLANEOUS.

University of London.—First B.Sc. and Preliminary Scientific (M.B.) Examinations—Examinations for Honours.—The following is a list of the candidates who have passed the recent examinations:—*First B.A. and First B.Sc. conjointly.*—Mathematics and Mechanical Philosophy: First class. J. Snelling Morris (Exhibition), St. John's College, Cambridge; Sidney White, University College; Frederick Charles Kolbe, University College. Second class. George W. von Tunzelmann, University College; George Charles Frames, Royal School of Mines. Third class. Robert Pickett Scott, Middle Class School, Cowper Street; Richard Henry Chope, Wesley College. *First B.Sc. and Preliminary M.B. conjointly.*—Chemistry: First class. William Hewitt (disqualified by age for Exhibition), Royal School of Mines; Thomas Samuel Humpidge (Exhibition), Royal School of Mines; A. Robinson Wilbs (disqualified by age for Exhibition), Royal School of Mines; W. Wansbrough Jones, Magdalen College, Oxford. Second class. Greville Matheson McDonald, King's College; Herbert A. H. Fenton, University College; Louis Alfred

Cantin, St. Bartholomew's Hospital; William Joseph Spratling, private study and Royal School of Chemistry. Third class. Alfred Henrick Jackson, Owens College; Archibald McAlpine, Royal College of Science, Dublin; Arthur John Harries, University College; Nanda Kumár Ráy, University of Edinburgh; Richard Bredin, Liverpool Royal Infirmary School of Medicine and private study; William Bartlett Hinton, Guy's Hospital. Experimental Physics: First class. Leonard Charles Wooldridge (Arnott Exhibition and Medal), Guy's Hospital; G. Brown, Owens College; William Hewitt, Royal School of Mines; George William von Tunzelmann, University College. Second class. William Wriothesley Colborne, University College; Cecil Reeves Harrison, University College. Third class. Albert Edward Tovey, private study; Ambrose Robinson Willis, Royal School of Mines.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of soap. Pascal Lombardon, soap manufacturer, of Forest Hill, Kent. October 27, 1874.—No. 3715. The object of my invention is to perfectly saponify all the fatty matters contained in the grease of which the soap is made. This is effected by means of a lye or alkaline compound, consisting of carbonate of soda, quick lime, common salt, and alum.

An improved process for the preservation of animal substances from decay. John Farmerley Dickson, chemist, Leicester. October 29, 1874.—No. 3745. According to this invention the meat to be preserved is cut into joints, and placed first in a bath composed of a saturated solution of borax to which has been added one-fourth part by weight of sulphuric acid; after washing, the meat is placed in a second bath composed of one part of ordinary sulphuric acid diluted with 10 per cent of water; finally, the meat is placed in a third bath of the same composition as that first described.

An improved process of purifying liquids and recovering matter contained therein. George Mackay, manufacturing chemist, Edinburgh, Midlothian, North Britain. October 30, 1874.—No. 3751. The features of novelty which constitute this invention consist in the purification of such liquids as contain animal, vegetable, or mineral matter by the admixture therewith of per-salts of iron, and thereafter adding a caustic or carbonated alkali or alkaline earth, and in the recovery by this means of the matter held in solution or suspension by the liquid so treated.

Improvements in treating aniline and other dyes to prepare them for use in dyeing, printing, and colouring. Maximilian Zingler, Buckland Crescent, Belsize Park, Middlesex. October 30, 1874.—No. 3757. This Provisional Specification describes dissolving aniline, &c., in bisulphide of carbon, with camphine, turpentine, &c.

Improvements in the treatment and utilisation of sewage, and in means employed therein. Burton Henry Vallé, Stow in the Wold, Gloucester. November 3, 1874.—No. 3784. According to this invention the sewage is collected in filtering tanks, the sludge being completely utilised for the manufacture of illuminating gas and a substance capable of defecating sewage and useful for other purposes, while the liquid portion is rendered fit for domestic use.

Improvements in deodorising and disinfecting materials, and in apparatus for applying the same. Francis Thomas Bond, M.D., Gloucester. November 4, 1874.—No. 3799. The Specification describes the preparation of a disinfecting compound by combining either one or more of the following salts in a pulverulent form, viz, the sulphates or chlorides of iron, alumina, and copper, and the bichromate of potassium, with carbolic acid or with terebene, one of the isomers of oil of turpentine. Also the preparation of a deodorising and disinfecting liquid by the solution of the compounds formed as above in water, or by combination of saturated solutions of the respective salts with terebene or carbolic acid. The Specification further describes a simple form of vessel for attachment to the lid of a water-closet or commode, by means of which a measured quantity of the disinfecting solutions thus formed may be projected into the pan.

An improved artificial fuel. Frederic Dixon, Southgate Road, Islington, London. November 11, 1874.—No. 3880. The use of dextrine, fusel oil, and soda alum in the manufacture of artificial fuel composed of coke, peat, or small coal disintegrated.

Improvements in the treatment of spent oxide of iron, for the purpose of extracting cyanogen compounds therefrom. William George Valentin, of the Royal College of Chemistry, South Kensington, Middlesex. November 12, 1874.—No. 3908. The washed "spent oxide" is digested at the temperature of boiling water with carbonate of lime, with carbonate of magnesia, or, by preference, with slightly burnt dolomite or magnesian limestone. The aqueous solution after filtration contains ferro-cyanogen as ferro-cyanide of calcium or magnesium, as the case may be, or of both, and constitutes a light yellow, very slightly alkaline liquid, which, on the addition of a small quantity of acid and of a salt or salts of iron, yields a precipitate of Prussian blue. The process is equally applicable in the case of "spent oxide" from which the soluble salts have been removed by water, and the sulphur by extraction with carbon disulphide. The ferric-oxide which is then left, and which usually contains some magnesia salt which has not been acted upon, is improved thereby, and can be used over again for the purification of coal-gas.

NOTES AND QUERIES.

Rendering Wood Incombustible.—Can any of your readers inform us what chemical preparation will render wood non-combustible? Will tungstate of soda do it effectively?—A. K. & Co.

Deodorisation of Paraffin Oil.—Perhaps you can tell me if there is a means of preventing the disagreeable odour from paraffin without sensibly diminishing its light- and heat-giving qualities. If you should not know of any means, perhaps some of your readers may if you will kindly insert the question, for which I should feel very grateful.—A. W. BRYANT.

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THE CHEMICAL NEWS.

Vol. XXXII. No. 829.

THE YORKSHIRE COLLEGE OF SCIENCE.

An occasion of such importance to the county of York as the inauguration of the College of Science at Leeds, last week, by the Duke of Devonshire, merits more than a passing reference. Stimulated by the example of Owens College, Yorkshiremen in general, and Leedsmen in particular, are attempting to do for their county what the men of Manchester in general, and John Owen in particular, have already done for Lancashire. The people of Leeds, however, distinctly disclaim the idea that the College is in any sense a local institution. That it has been located in Leeds arises simply from the fact that this town is the largest in the district, that it is the centre of a great variety of manufacturing industries, and is the converging point of several extensive railway systems. There is no reason, as Mr. W. E. Forster told his constituents, why the people of Bradford, of Halifax, or of Huddersfield, should not equally regard it as their College. Representative men from these and from every other important town in the Riding are on its executive, and have assisted in its establishment, either by their money or their counsel. In commercial and municipal matters there is a healthy rivalry between these towns, which has shown itself in the number of excellent institutions and good works which it has called forth, but in the special labour of organising the College we are glad to see the towns working in a common cause and to a common end. When we bear in mind that our manufacturers are now fully alive to the fact that foreign competition is seriously telling upon their supremacy, and that the cry for instruction in those sciences which are at length beginning to be recognised as constituting the basis of our chief industries is being heard in almost every large town in the country, it seems extraordinary that the men of the West Riding, who are so intimately dependent on applied science, should have delayed their effort so long. The fact is, as Mr. Forster told the people of Leeds, that the call which has been made by civilisation upon civilised people had been more quickly responded to by Germany, Switzerland, Holland, and even by Sweden and Norway, than by England. We have a habit of being late, and we may congratulate ourselves if our tardiness and procrastination has not thrown us irretrievably behind.

The Yorkshire College of Science has grown out of the labours of the General Council of the Yorkshire Board of Education. Fully impressed with the necessity that something must be done to improve the character of those industries in the district which rest upon applied science, they drew up a scheme which contemplated the supply of the highest standard of instruction in chemistry, mining, and metallurgy, civil and mechanical engineering. Recognising, too, the source from which much of the aliment of the College must come, they sought to make provision for the education of teachers to be employed in the ordinary science schools of the district. The result of their appeal to the country in furtherance of these objects has been that a sum of about £36,000 has already been collected. The Duke of Devonshire and Sir Andrew Fairbairn have each given £2000; Sir Titus Salt, Messrs. Beckett and Co., Messrs. Hargreves and Nussey, and the Low-Moor Iron Company have each given £1000; and more than sixty noblemen and gentlemen have given sums varying from £250 to £500. The Endowed Schools Commissioners have made over an endowment of £400 a year, and the Worshipful Company of Clothworkers of the City of London have created an endowment of £300 a year and have founded several scholarships. Although only in temporary premises, the College is very comfortably situated in regard to teaching appliances and conveniences. It possesses good lecture-rooms, an excellent chemical laboratory, a private laboratory for the Professor of Chemistry, rooms for the balances, and for gas analysis and spectroscopic inquiries, a large lecture and loom room for the department of textile industries, private rooms for the Professors, students' room, and other offices. The amount of public support which the scheme has met with is very gratifying, but much remains to be done; and, if the College is to be worthy of the great county from which it takes its name, additional efforts must be made. We should like to see its curriculum extended, and the scope of its teaching considerably enlarged. We trust that Yorkshiremen will not see an institution launched under such favourable auspices starved or crippled for want of the necessary funds. It must be remembered, as the Duke of Devonshire pointed out, "that colleges and institutions for higher education have a very voracious appetite, and that, with great advantage to the public, they could lay out almost any amount of money the public bestowed upon them."

FUNNELS WITH AUXILIARY VERTICAL TUBES

By P. CASAMAJOR.

In a recent number of this publication (see Chem. News for July 30, 1875) I have given descriptions of two new funnels, suitable for filtration under pressure. One of these, which is intended to be used in the manner proposed by Dr. Carmichael, must be assisted by an aspirator, on account of the necessity of holding the filtering disc and perforated metallic plate upwards against the funnel. The other funnel, intended for downward filtration, may be used either with an aspirator or simply with an auxiliary vertical tube, which, by holding a column of water, produces the necessary suction.

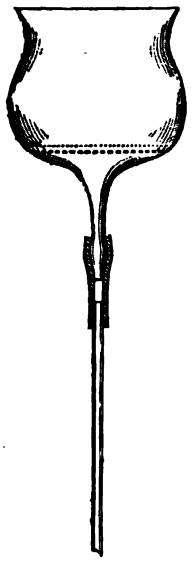
Since the publication of the above-mentioned descriptions, I have had occasion to see this latter funnel tried with a vertical tube by persons whose only instructions were derived from those descriptions, and I regret to say that the results obtained were not satisfactory. This circumstance induces me to return once more to the subject, with the hope that the instructions about to be given will be found so explicit as to afford sufficient guidance.

The annexed sketch and the description which follows, present the shapes and dimensions which have given the best results. In the funnel may be seen the paper filter and metallic perforated plate, the former being represented by a fine dotted line, while the latter is shown by a line of coarse dots. The stem of the funnel ends in a slightly expanded portion, which is intended to prevent the rubber tube from slipping off. The rubber tube also goes over a glass tube whose diameter need not be greater than $\frac{1}{4}$th of an inch. The length of it need no-

greater than 14 or 15 inches, which would make the distance from the perforated metallic disc to the lower end of the glass tube, about 18 inches.

To use this funnel so arranged, a perforated metallic disc is taken, and over it is placed a paper disc with a diameter about ¼ inch greater, in such a way that the two discs are concentric, so that the border of paper left beyond the plate is of the same width all around. Afterwards the paper is soaked with water, which makes it adhere to the metallic disc, and both are placed in the funnel, the paper funnel above the perforated disc.

We may now lay the borders of the paper disc down on the funnel by pressing with the fingers. After this, if we move the paper disc horizontally, we will see that the filter does not adhere to the funnel; and if we should put water in the funnel, the filter will probably become displaced. If we should put in the funnel a liquid holding a precipitate, the turbid fluid would find its way under the filter and descend into the vertical tube. This constitutes the difficulty to which I have referred as having been encountered by persons using these funnels. To



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insure the satisfactory working of these funnels with a vertical tube, it is necessary to make the paper disc adhere to the bottom of the funnel before attempting to use it for filtration. This is easily accomplished by pouring into the funnel a certain quantity of water after the borders of the funnel have been pressed down. While the water is being poured in, the disc should be held down with a finger to keep it in its place. After the water has run out of the funnel, we may observe whether the vertical tube remains full of water. If the tube remains empty, the borders of the paper disc must be pressed down all around, and a new quantity of water must be poured into the funnel as before. If, after all the water has left the funnel, the vertical tube remains full, it shows that the paper disc adheres to the funnel, and the apparatus may be considered ready for filtration. If now we try to move the filter horizontally in the funnel, we will find that it is a difficult matter to accomplish, as the suction caused by holding up the column of liquid in the vertical tube makes the paper disc adhere strongly to the funnel. If we now pour a liquid into the funnel, we may observe that it runs very rapidly through the paper disc until the funnel is empty, but that, after it has run out, the tube remains full of water as before. This shows that although the paper disc allows water to run through it very readily, it seems impermeable to air, which may be due to this, that when the paper is, so to speak, saturated with water, its texture becomes looser and more porous, and allows water through it easily, but when it has become partially dry from the suction due to the vertical column of water in the tube, its texture contracts and becomes closer, so that no air can pass through it to satisfy the vacuum under the filter. Were it not for this property of the porous material of the filter, it would not be possible to use a vertical tube with these funnels instead of a filter pump. We may also see that it would be quite impossible to use a conical funnel in this manner, as, in these funnels, there are always channels for the air in the folds of the filters, and a vertical column of liquid could not be maintained.

I have already called attention to the great superiority of these funnels over ordinary conical funnels for washing precipitates. The whole of the liquid used for washing has to go through the precipitate, and not partly over it, as in conical funnels. The precipitate left on the paper disc is also much drier than happens with precipitates on conical filters unassisted by aspirators. A precipitate of iron peroxide, five minutes after the last wash water has passed through it, is so dry that it leaves but a slight stain on a finger pressed on it, and has already began to crack into little slabs which may be separated from the filter without difficulty.

The condition of dryness in which a precipitate is left with this filter, has induced me to try it for washing commercial sugars with alcoholic solutions of pure sugar, as in the Payen-Scheibler process. The results obtained have been so satisfactory, that I no longer use the filtering pump for this purpose. When quite a number of samples have to be washed at the same time, the funnels with vertical tubes present this superiority over the arrangements now in use, that every funnel has in its vertical tube an independent aspirator. I propose to return to this subject in a future paper on the Payen-Scheibler process.

Instead of a paper disc, a very good filter may be made by pouring a small quantity of thin paper pulp over the perforated plate previously placed in a funnel. This paper pulp is very soon drained of its water. It coats very evenly the top of the perforated disc and the interior of the funnel a little above the edge of the metal disc. Paper pulp is very readily prepared by disaggregating filtering paper in water. A pulp is also readily made from asbestos, which may be freed by washing from any clay or fine dirt. Asbestos is very well adapted for filtering strong acids or alkaline solutions.

A very good filter for mercury is made by using a perforated iron plate, over which is poured a pulp of paper or asbestos. This must be allowed to dry, as, when wet, mercury will not filter through it. For mercury a filter pump must be used, as it runs through the filter in mere dribblets, even when a powerful suction is used.

471, Lafayette Avenue, Brooklyn,
Sept. 15, 1875.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 164.)

Tessié du Motay and Maréchal† have introduced a valuable modification into practice, as they require no steam-boiler for the manufacture of the water-gas, and

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† *Bull Soc Chim.*, 1868, i., 334.

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thus economise fuel, whilst the wear of the simplified apparatus is considerably reduced. They heat coal with soda, hydrate of lime or of baryta in iron retorts, and thus decompose the combined water of these bases, which is then freed from carbonic acid in the ordinary manner. This procedure has been adopted by the New York Oxygen Company, who, in the manner described above, sell water-gas at the enormous price of 2 cents per cubic foot, or 1 cubic metre for 3s. 6d.* The mixture of lime and anthracite is heated in retorts such as those described above under Tessié du Motay's method of preparing oxygen. The decomposition takes place at a red-heat, according to the equation—

$$C+CaO+\tfrac{2}{3}H_2O=CaCO_3+2H_2,$$

and lasts about fifteen minutes. Thereupon hydrate of lime is re-formed by passing steam over the heated mass. The carbon is not exhausted until after three weeks, and is then replaced by a fresh supply of anthracite.

That coal-gas contains large quantities (30 to 50 per cent) of free hydrogen, and that the proportion of this ingredient rises, the higher the temperature of the retorts in preparing the gas, has long been known. Tessié du Motay and Maréchal, whilst introducing the above-described procedure, have taken advantage of this circumstance, and have passed coal-gas over lime in order to resolve it into carbon, hydrocarbons boiling at high temperatures, and large quantities of hydrogen. At the same time E. Vial† adopted the same method, and has doubled, and even trebled, the yield of gas by "decarburation." Schinz‡ doubts the industrial value of this process, on account of the outlay for fuel, and calculates that the decompostion of water by means of coal yields a luminous gas for half the cost of coal-gas. Here, however, as we shall presently see, the depreciation of the plant has not been taken into account.

If we now enquire in what manner the hydrogen, however obtained, is rendered luminous, we find two essentially different methods. The one depends on mixing the water-gas with hydrocarbons. As early as 1834|| Selligue employed, at Paris, the oils obtained by distilling the marl-shales of Autun in order to saturate the water-gas with gaseous hydrocarbons. White subsequently passed the water-gas through retorts in which rosin or coal was converted into luminous gas, and his process was carefully examined in 1851 by Frankland,§ who concludes a laudatory report with certain propositions, of which the following are the most important:—

1. The production of gas from given weights of common coal or of cannel is increased by 46 to 290 per cent, according to the quality of the material employed.
2. The luminous power is increased by 12 to 108 per cent, the more when coals are employed which produce gas of a highly luminous power.
3. The quality of the residual tar is lowered, a part of it being converted into gas of a strong luminous power.

It must be remarked that tar had not at that time the value which it has subsequently reached.

White's process recurs, with trifling modifications, under a variety of names.

The Royal Polytechnic.—A new lecture entitled "Flames and Flares" and their characteristics has just been introduced at the above Institution by Professor Gardner. The lecture is illustrated with some interesting experiments.

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* H. Vogel, *Ber. Chem. Ges.*, iii., 901.
† Vial, *Genie Industriel*, 1869. *Dingl. Pol. J.*, cii., 382.
‡ Schinz, *Dingl. Pol. J.*, cii., 388.
|| Dumas, "Handbuch der Chemie," vii.
§ Frankland, *Ann. Chem. Pharm.*, lxxxii., 48.

REPORT ON
THE METHODS EMPLOYED IN THE
ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS,
AND ON THE
MODE OF STATING THE RESULTS.*

(Continued from page 172.)

"*Reduced*" *Phosphates.*

Of all the chemists who have communicated with the Committee, only two consider that the so-called "reduced" phosphates can be estimated even approximately by any known method. One of these writes as follows:—"I employ a process based on the ready decomposition of gelatinous phosphate of lime by oxalate of ammonia, and the almost complete inaction on the mineral phosphate by the same salt. Although not an exact process, it gives good approximate results within half a per cent; and seeing the urgent need for some such means of estimation, more especially in the case of bone-manures, in which a large proportion of decomposed phosphate may exist unrecognisable by the ordinary soluble phosphate determination, I think it better to employ even an imperfect process than to classify such decomposed phosphate with undecomposed mineral phosphate."

Professor A. H. Church, referring to the bicarbonate of sodium method, described on page 146 of his "Laboratory Guide"† (3rd edition), writes:—"It is the only method giving approximate results."

A series of highly instructive experiments on the estimation of "reduced" phosphates has been contributed by Mr. M. J. Lansdell. With the oxalate of ammonium method of Mr. A. Sibson,‡ and with the bicarbonate method (which was first described by Mr. Chesshire§), Mr. Lansdell obtained the following results—the samples being all passed through the same sieve, and the proportions employed being the same as those recommended by the authors:—

	Sample Contained. Equal to $Ca_3P_2O_8$. Per cent.	Dissolved. Equal to $Ca_3P_2O_8$. Sibson's Method.	Dissolved. Equal to $Ca_3P_2O_8$. Chesshire's Method. Per cent.
Cambridge coprolite.. ..	56·07	8·32	2·23
Bone-ash	76·87	10·58	3·07
Navassa phosphate	65·62	7·48	5·73
German phosphate	60·74	8·04	2·09
Redonda phosphate (dried)	87·42	19·72	56·97
" " (lump)	86·58	19·10	64·65

By employing a solution of bicarbonate of twice the above strength the Redonda phosphate gave P_2O_5 equal to 84·3 of $Ca_3P_2O_8$ in solution. Using a smaller quantity of the sample in the oxalate method, 47·76 per cent passed into solution.

The above results show that neither method is at all satisfactory, and Mr. John Hughes|| has made experiments leading to the same conclusions.

Another correspondent writes:—"There is no reliable process known for the estimation of 'reduced phosphates' under all circumstances. Even the citrate of ammonium method, which seems to be the one generally preferred, utterly fails to distinguish between 'reduced phosphates' and the native phosphate of aluminium, known as

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* Presented to the British Association, Bristol meeting. Report of a Committee of Section B, consisting of E. C. C. Stanford, Chairman James Dewar; Alfred E. Fletcher; and Alfred H. Allen, Hon. Secretary.
† This process consists in boiling the insoluble portion of 5 grms. of the sample for one hour with a solution of 10 grms. of sodium bicarbonate in 300 c.c. of water, filtering hot, acidifying, concentrating, precipitating with magnesia, &c.
‡ Chemical News, vol. xx., p. 123.
§ *Ibid.*, vol. xx., p. 111.
|| *Ibid.*, vol. xix., p. 266.

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'Redonda phosphate,' the latter being largely soluble in the citrate of ammonium solution; so that the latter, which is a comparatively cheap material, if introduced into a superphoshate, would, according to the results obtained by the methods usually employed for estimating reduced phosphates, be quoted as the latter."

Mr. T. L. Patterson has criticised the citrate of ammonium method in a paper contributed to the CHEMICAL NEWS (vol., xxv., pp. 255 and 268).

Mr. W. Galbraith makes the following remarks on the estimation of "reduced phosphates":—"It seems to me that an arbitrary method of determining these phosphates would serve every purpose; that is, provided there is a necessity for determining them (from a commercial point of view), which I am inclined to dispute; because any other phosphate in as fine a state of division as these 'reduced phosphates' is of equal value, and if (as some chemists maintain) these 'reduced phosphates' consist principally of phosphates of iron and aluminium, they cannot, and should not, be reported or assumed to be phosphate of calcium. It is well known that the presence of oxides of iron and aluminium is the cause of the manure 'going back.' Superphosphates containing no iron or aluminium do not 'go back,' so that the manufacturer has the remedy in his own hands—to avoid using mineral phosphates containing iron and aluminium. At present a manufacturer who makes his manure from a phosphate containing iron and aluminium, and who sells it immediately after manufacture, has a decided advantage over another manufacturer who has made his manure from a phosphate containing no iron and aluminium, because a mineral phosphate containing iron and aluminium is much cheaper than one free from these substances. Besides, the iron and aluminium are almost invariably stated in the analysis of a mineral phosphate, while these substances are seldom, if ever, mentioned in the analysis of a superphosphate. I do not think it advisable, even if possible, to determine the *actual* amount of 'reduced phosphate,' but an arbitrary method, or a method of determining phosphate of given fineness which would include 'precipitated phosphate' would, I think, be very serviceable, and such a process could be easily devised."

Statement of the Commercial and Agricultural Value of Manures.

Without exception, all the chemists who reply to this question are of opinion that it is highly undesirable that analysts should express any opinion on the commercial value of a manure. Many of them are of opinion that tricalcic phosphate, for instance, has a very different value according to its origin and state of division, and that any valuation of a manure not taking this and similar facts into account must be worse than useless. Most of the chemists who have replied consider that phosphates of iron and aluminium have an exceedingly limited manurial value. The *relative* manurial value attributed to phosphoric acid existant in different states is very differently regarded, and as many of the opinions expressed appear to be based on very insufficient evidence, the Committee think it unnecessary to quote the various replies received.

Mode of Occurrence of the Constituents of Manufactured Manures, and Statement of the Results of Analysis.

On this subject the Committee has received a large amount of valuable, but somewhat discordant, evidence. Very strong opinions are expressed to the effect that the quantity of iron and aluminium present in a manufactured manure (superphosphate) should always be stated. Such a plan would enable the manufacturer or purchaser to judge of the probability of a newly made manure "going back" on keeping, and would enable a more accurate opinion to be formed of its true value than is possible while the presence of iron and aluminium is ignored. At the same time, the estimation of the "reduced phosphates" would often be rendered superfluous.

With respect to the mode of occurrence of the constituents of manufactured manures, the Committee considers the evidence before it too vague and conflicting to justify any expression of opinion at present.

(To be continued).

ON THE MANUFACTURE OF WHITE CAUSTIC SODA.*

By GEORGE E. DAVIS, F.C.S.

(Continued from p. 177).

Section 2.—Lixiviating the Black-ash.

When the black-ash is made it is allowed to stand on the ball bank until required for use; this time depends upon the stock of balls kept in hand, and may vary from a day to a week. When required, the balls are broken in pieces (each ball into nine or ten pieces) and placed in vats usually about 9 ft. square, and varying in depth from 4 to 6 ft. according to circumstances. These vats are usually worked in sets of four, though there are places where they are worked in sets of three, of five, and one, at least where they work in a set of eight. The vats are worked in connection with each other; water at temperatures varying from 90° F. to 150° F., running on to the weakest vat, and liquor at 53° T., at 120° to 140° F., running off the newly filled or strong one. When the weak vat has been run down to 3° to 4° T. warm water is run on to it, the resulting liquor being run off into what is called the weak liquor well. It usually possesses a sp. gr. equal to 1° to 2° T., and the following analysis may serve o show its composition:—

1° T. = sp. gr. 1·005

Sodium hydrate	2·640
,, carbonate	1·060
,, sulphide	2·690
,, hyposulphite	0·554
,, sulphate	0·284
,, chloride	6·780
,, silicate	0·100
,, aluminate	0·108
Total solids per litre	14·216

This liquor is used before water for the next vat, and only when this supply is exhausted is fresh water used, so that there should be in properly arranged vats but very little loss of soluble alkali.

The strong vat generally starts running off at 54° T., at 130° F., and in some caustic works is kept at such a strength that the resulting liquors will stand about 50° T., at 110° F.; in this case it will contain the minimum of sodium sulphide. Others run the liquors so that they will stand 36° T., or at all strengths between these two extremes.

Kolb has shown the principal points to be watched in the lixiviation of black-ash; they may be enumerated thus:—1. Rapid lixiviation. 2. The avoidance of high temperatures. 3. The employment of as little water as possible. He also states that the quantity of water used is without influence on the causticity of the liquors, but the amount of sulphides increase with the quantity of water. The proportion of sodium sulphide to the quantity of alkali in solution does not increase much until the liquors are run below 40° T.; there is an increase, but not a considerable one, and the proportion of caustic alkali to the carbonate I have always found to be a constant number for all strengths above 10° T. in the same vat.

After leaving the vats the liquor is generally run into settlers, where sulphide of calcium is deposited, together with some sulphide of iron, and a large quantity of the insoluble double silicate of alumina and soda, formed by

* From the *Journal of the Society for the Promotion of Scientific Industry.*

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the mutual reaction of the silicate and aluminate of soda upon each other.

The following (A) is an analysis of the deposit from a settler, after being carefully washed and dried in a current of hydrogen, and by its side (B) may be seen an analysis of the double silicate of aluminate and soda, which forms a crust upon concentrating pans, making caustic ash, and also falls to a large extent in the settlers :—

	A.	B.
Silica	23·60	39·572
Alumina	18·44	33·584
Sodium oxide	13·12	20·776
Water	—	5·844
Iron sulphide	5·84	—
Calcium sulphide ..	38·00	—
	99·00	99·776

The black-ash originally and before lixiviation probably contains cyanide and sulphocyanide of sodium, together with iron peroxide. This last is transformed into iron sulphide in the vats, which becomes the means of changing the cyanide of sodium into ferrocyanide. This ferrocyanide exists in black-ash liquors, in very varying quantity, often containing none, whilst at other times they are highly charged with it. If the iron sulphide is not in sufficient quantity to convert all the cyanide, or if a sufficient temperature has not been reached in the vats, the cyanide is decomposed during the ebullition of the liquors on concentration, ammonia being evolved, and sodium formiate remaning in the solution.

The hyposulphite is without doubt formed by the oxidation of the sulphide, and there is great probability that the oxide of iron present has something to do with this oxidation.

Other constituents are present in small quantity, and to conclude this section I give two analyses of vat liquors, the results being expressed in grammes per litre :—

	50° T. at 90° F.	50½° T. at 90° F.
Iron sulphide	0·074	0·042
Sodium sulphide	4·485	3·822
,, sulphite	1·323	0·979
,, hyposulphite	1·580	1·774
,, sulphate	12·707	14·258
,, chloride	19·597	23·412
,, silicate	5·961	3·774
,, aluminate	3·371	4·218
,, ferrocyanide	0·133	0·416
,, sulphocyanide	0·211	0·196
,, phosphate	traces	traces
,, fluoride	traces	traces
,, carbonate	209·500	204·326
,, hydrate	44·800	52·740
Total solids per litre	313·742	320·857

Traces of the following oxides also exist in solution :— calcium oxide, manganese oxide, and magnesium oxide.

The vat liquors should be chemically examined morning and evening, and the results may be arranged in the following form :—

Date.	Deg. T.	Deg. F.	Total alkali.	Caustic alkali.	Na_2S.
June 17	52°	140°	184·0	63·8	5·62
July 14	53°	124°	190·6	68·4	4·96

The above are expressed in grammes per litre.

Section 3.—*Causticising.*

The settled vat liquor is now diluted with water and heated to boiling, and manufacturers are not of one opinion as to what should be the extent of this dilution. Some works causticise at 15° T., while a few prefer 20° T., all other works preferring a gravity of their own, ranging between these two extremes. Quicklime is then added, and the whole steamed and agitated until the "operation" is thoroughly causticised. The extent of this causticisation is generally left to the workman, who takes out a sample and allows it to settle; the clear liquor being poured into a test-tube should show no effervescence when treated with an excess of any dilute acid; but I would insist upon the strict watch being kept over this process as I have in the two previous sections.

The operations are usually causticised in pans of no definite size, old boilers cut in halves being frequently employed, and there exist two distinct methods of agitation; one, in which the agitation is produced by the injection of air, in the other mode it is produced by mechanical arrangements.

The first method possesses the advantage that while the liquor is being agitated the sulphides are being oxides; in the mechanical method no oxidation of the sulphides can take place.

The carbonate of lime which settles in the pan is generally removed after every second operation. After the operation has been allowed to settle the clear liquor is run off, and another batch of diluted liquor run upon it; more lime is added, and this second batch is causticised, and, after settling, the clear liquor is run off. Water is then generally added to the mud, which is agitated and steamed, after which the carbonate of lime is allowed to settle, and the clear liquor which is run off is used for diluting the next batch of liquor. The mud which remains is now plunged up with a little water and run on to the filters, where it is allowed to drain, either by itself, or by the aid of a vacuum pump; it is then washed once or twice upon the filters with water, and afterwards wheeled away to the mixing of the black-ash.

The following are two analyses of lime mud from the filters, just as going in to the black-ash mixing :—

	A.	B.
Calcium hydrate	2·825	2·652
Sodium ,, ...	1·906	1·663
,, chloride and sulphate	0·244	0·206
Calcium carbonate	40·170	42·031
,, hydrate	3·756	3·072
Silica	0·673	0·774
Alumina	0·255	0·324
Iron peroxide	0·048	0·708
Magnesia	0·086	0·095
Soda	1·832	1·600
Water	47·986	46·577
	99·781	99·702

The first three bracketed were soluble when 5 grms. of the mud were digested in 100 c.c. water at 100° C.

I will now lay before you two analyses, of which A is of vat liquors simply diluted with water and before causticising, and B is the same liquor after causticising, the agitation of the operation being produced by means of the injection of air.

	A.	B.
Iron sulphide	traces	traces
		Fe_2O_3
Sodium ,, ...	1·068	none
,, sulphite	0·151	0·264
,, hyposulphite	1·137	1·864
,, sulphate	5·423	5·006
,, chloride	8·576	7·995
,, silicate	0·852	0·176
,, aluminate	2·490	1·438
,, carbonate	53·167	2·954
,, hydrate	44·280	74·000
,, ferrocyanide	0·093	0·086
,, sulphocyanide ..	0·054	0·050
,, phosphate	traces	traces
Insoluble	0·849	none
Total solids per litre	118·140	93·833

There were also traces of lime, magnesia, and manganese oxide in the solutions.

A had a gravity of 20° T. at 56° F., and B possessed a gravity of 18° T. at the same temperature.

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The next sample is from a works where it was preferred to causticise at 15° T., and the agitation of the operation was performed mechanically. When finished the gravity was 13° T. at 52° F. The ferrocyanide, sulphocyanide, and other like constituents were not estimated:—

Iron sulphide	traces
Sodium ,, ...	1·092
,, hyposulphite	1·264
,, sulphite	trace
,, sulphate	3·264
,, chloride	4·212
,, silicate	0·151
,, aluminate	0·584
,, carbonate	7·844
,, hydrate	50·400
Other constituents	0·200
Total solids per litre	69·011

Now, in the agitation by injection of air as in analysis B, it will be seen that the sulphide has been completely oxidised. The first stage in the oxidation is the formation of hyposulphite and sodium hydrate, after the following equation:—

$$2Na_2S+4O+H_2O=Na_2S_2O_3+2NaHO.$$

Upon continued blowing in presence of alkali, I am informed by an experienced chemist in the alkali trade that sulphate is the ultimate product. I cannot confirm this by direct experiment, but the analyses given above show that although some sulphate and sulphite was produced, yet during the time the operation was blown very little but hyposulphite was formed.

I have mentioned in previous part of this paper that the use of the various metallic oxides has been patented from time to time for the purpose of eliminating the sulphides from the alkaline liquors. The oxides of iron, zinc, and manganese have often been tried by experimenters, but they have all been abandoned, and even the zinc oxide, which seemed to promise so much, has been found not to work well in practice; the zinc sulphide which is produced is a slimy precipitate which does not settle well in the alkaline liquor.

The only oxide which is practically useful is that of lead, and litharge has been used in at least two works with much success, but care is required in its use, or it becomes a serious item in the cost of production.

When litharge is used it is sometimes put into the causticising pan in small quantities at a time until the settled liquor shows but a slightly black colour with a solution of lead acetate. With fair liquor in practice the litharge used will amount to rather less than 50 lbs. per ton of 60 per cent caustic, and the nitrate of soda used in finishing is reduced thereby to less than 6 lbs. per ton of caustic. The litharge being very heavy renders it necessary to agitate the operation very energetically, and the agitation should be performed mechanically, no oxidation by any means being allowed, as when the sulphide is decomposed by litharge an equivalent of alkali is liberated; but when oxidised it eventually becomes sulphite, which if skimmed off the pots is only of the value of salt cake, and if it remains in the caustic is only of the same value as salt.

Probably the best way of using the litharge is to previously dissolve it in some strong caustic liquor of 50° T.; a great deal will remain at the bottom undissolved, and the clear liquor only is run into the causticiser until the decomposition of the sulphide is effected. By this means no litharge is wasted, fresh caustic liquor of 50° T. being applied to the undissolved litharge for effecting its solution.

The sulphide of lead which is formed settles very readily and remains mixed with the lime mud; but this in no way interferes with its use in the black-ash mixing.

Now, as to the dilution of liquors. Some manufacturers causticise at 14° T., because they say that at a higher gravity the carbonate of soda is not decomposed, while others say that although it is decomposed, yet it takes a longer time at a higher gravity.

I have satisfied myself that these statements have no foundation in fact, and that causticising at 20° T. is as easy as at 15° T., and takes no longer proportionate time. In the analysis B causticised liquor there are 74·0 grms. of sodium hydrate in the litre, and 97 per cent of the alkali has been causticised; in the second sample at 13° T. there are only 50·4 grms. per litre, and only 90 per cent of the alkali has been causticised. To look at it in another light, in the second sample nearly half again as much water has to be evaporated than in the first operation; the ratio of water to solids is 14·6 to 1 in the last sample, and only 10·6 to 1 in the first.

These operations are too often left entirely to workmen or working foremen, who perhaps forget that it *pays* to spend half as long again over an operation, or to use half again as much lime if there is one and a-half times the quantity of alkali in one batch, or, what amounts to the same thing, less water to evaporate, in this case amounting to no less than 4 tons for every ton of 60 per cent caustic.

Before leaving this section I wish to point out that most of the silica existing in the vat liquors as sodium silicate is eliminated in the causticiser; according to the analyses A and B of the liquor before and after causticisation, about 80 per cent of the silicate of soda has been decomposed, and in the analyses another salt of soda, viz., the aluminate, stands out very prominent.

The presence of the aluminate of soda is caused by the introduction of the solution of caustic bottoms. These bottoms are dissolved in water to between 20° T. and 30° T., and the clear solution is run into the operation pan with the diluted vat liquor.

Now, on adding lime to the operation an insoluble aluminate of lime is formed, and the analyses show that about 42 per cent of the aluminate of soda has been converted.

There has been much talk about re-converting this lime mud again into lime and using it continuously; but it must be remembered that in any process where impurities or any foreign matters of any kind creep in, there must be some outlet for them, and when we consider what a very small margin there is for working expenses in driving off the water and the carbonic acid, it seems very apparent that it never will be used continuously so long as it can be used up in the black-ash mixing for its equivalent of limestone.

Its conversion to lime has been tried in several works, especially soaperies, but has always been abandoned owing to the cost attending the operations.

To put it into a practical form. 1 ton of lime does its work in the causticiser, and produces 1·75 tons of carbonate of lime, making the cost of this carbonate 10s. 9½d. per ton, as against 7s., for which it can be purchased at the present time. Some, perhaps, would wish the soda to be calculated in; but there is no doubt that the major portion of this constituent is recovered in the black-ash, and enters the process again.

Taking things as they stand. Offer a lime burner, lime mud at 4s. 6½d. per ton of $CaCO_3$, and limestone at 7s., a practical man could not be at a loss to know which he would choose.

To conclude this section, I would again insist upon chemical supervision, and instead of leaving the operation entirely to the workman, a sample of the batch should be obtained when the operation is near completion, and the steam should not be turned off until the chemist in charge of the process has declared at least 94 per cent of the alkali to be causticised.

The results may be kept in a book in this form:—

Date.	No. of Batch.	Steam put on.	°Tw.	Total Na_2O.	Caustic Na_2O.	P.c. Caustic-cised.	Na_2S.	Stm. off.	°Tw.
	824	8.0 a.m.	14½°	43·64	39·06	90·0	1·09	11.0 a.m.	13°
	825	1.0 p.m.	20°	59·07	57·35	97·0	none	5.0 p.m.	18°

The liquor is now to be settled well until it is clear and bright, and on no account should it be run into the pans before it is in this condition.

(To be continued

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SOCIETY OF PUBLIC ANALYSTS.

ON TEA.*

By G. W. WIGNER.

(Continued from page 168.)

By considering together the forty samples of ordinary teas, and twenty-seven of special teas, we obtain a series of figures which may be taken to represent the limits of variation in genuine teas as imported.

Average of Sixty-seven Samples.

	Total Ash. Per cent.	Ash Soluble in Water. Per cent.	Ash Soluble in Acid. Per cent.	Silica.	Potash.
Average	5·78	3·15	2·17	0·46	1·45
Maximum	7·02	3·88	2·87	1·67	1·96
Minimum	5·17	2·64	1·33	0·04	1·08

The average results expressed in percentages of the total ash are—

Soluble in aqua	54·50 per cent
(Containing alkali calculated as potash 25·09)	
Soluble in acid	37·54 ,,
Silica	7·96 ,,
	100·00

while the maximum percentage of soluble ash calculated in the same way is 70·60, and occurs in a very high-priced sample of Oolong (53) and the minimum 38·33, which occurs in a very inferior sample of caper (74), though I believe, from a most careful examination, it was really genuine. If, however, the extraneous siliceous matter present in the sample is deducted, the proportion of soluble ash will be 45·86 per cent. The nearest approach to this figure is another caper (81) which gives 46·64 per cent soluble ash, and it is only in rare cases that a sample of any other tea but caper contains less than 50 per cent of ash soluble in water, and there is only one case in which the ash soluble in water falls below the ash soluble in acid, the figures then being 2·75 and 2·87 per cent.

If, instead of considering these samples in their ordinary state, the results are calculated to the dried teas, we get figures which are in some respects more nearly constant.

Thus the seventeen ordinary teas, after drying, give the following results:—

	Total Ash. Per cent.	Ash Soluble in Water.	Ash Soluble in Acid.	Silica.	Potash.
Average	6·25	3·34	2·43	0·48	1·50
Maximum	6·48	3·68	3·07	0·82	2·07
Minimum	5·98	2·94	2·15	0·16	1·26
And the eighteen special teas—					
Average	6·23	3·74	2·14	0·35	1·67
Maximum	7·42	4·16	2·91	0·93	2·11
Minimum	5·57	3·15	1·43	0·04	1·42
And the nine capers—					
Average	6·61	3·48	2·02	1·11	1·40
Maximum	7·33	3·84	2·05	1·46	1·42
Minimum	6·15	3·21	2·00	0·93	1·38
And again putting the whole of the sixty-seven samples together, after drying—					
Average	6·33	3·45	2·38	0·50	1·54
Maximum	7·42	4·16	3·07	1·76	2·11
Minimum	5·57	2·94	1·43	0·04	1·26

* Read at a meeting of the Society of Public Analysts at the Museum and Library, Bristol, August 26, 1875.

In the original teas the variation in total ash amounts to 32 per cent of the average, but in the dried teas it is only 29·3 per cent, while the variations in alkali in the original teas are 63·5 per cent of the average, and in the dried teas only 55 per cent.

Having thus carefully considered all the principal species of teas as imported, we will pass to retailers' samples. It is, of course, an uncommon thing to buy an unmixed sample of tea at a shop. The true art of the tea dealer consists in this blending of teas, and there can be no doubt that the consumer gains by it. It is, however, inevitable that in this mixing a small amount of dust and dirt should be introduced, and the proportion to which this occurs may be fairly estimated from the following figures, which are the average, &c., of thirty-three retailers' samples. These include almost every price and quality of tea:—

	Total Ash. Per cent.	Ash Soluble in Water.	Ash Soluble in Acid.	Silica.	Potash.
Average	6·39	3·29	2·39	0·71	1·30
Maximum	7·25	3·91	3·35	1·45	1·78
Minimum	5·15	2·71	1·38	0·20	0·94
Or if the results are calculated to the dried tea—					
Average	6·74	3·58	2·52	0·69	1·48
Maximum	7·79	4·22	3·68	1·56	1·98
Minimum	5·69	3·11	1·63	0·22	1·06

These results show about ½ per cent of extraneous matter, *i.e.* dirt added in the mixing process, which is probably quite as little as could be reasonably expected. The average percentage of soluble ash remains almost the same, and the percentage of alkali is slightly less.

Passing from the ash to the extractive matter, I find it is by no means a matter of indifference in what way this is determined. The proportion of soluble matter yielded by tea differs very greatly according to whether the tea is powdered or in whole leaf, and also according to the amount of water used and the number of extractions to which the sample has been submitted. The most accurate method would appear to be to powder the leaves, and then boil them repeatedly, filtering each time until no more soluble matter can be extracted; but in practice this process proves to be almost interminable, and it may be from this cause that the results sometimes announced in disputed cases have been so discordant. Samples which have been powdered and boiled four times in succession with 100 times their weight of water each time, and carefully washed on the filter, still yield more soluble matter on re-boiling. I prefer, therefore, for reasons which I will give, to adopt a different method.

Powdered tea almost invariably yields more extract than whole leaf tea, but the excess is variable; in some cases it is only 1 per cent, and in others as much as 5 or 6 per cent. I cannot, however, discover any rule or apparent regularity in this variation. It is easy to obtain uniform results from the powdered samples, but impracticable to do so from whole leaf; I have, therefore, always adopted the rule of powdering.

I have made many experiments to determine the relative proportions of soluble matter yielded when tea is treated in different ways; and the following, which were made on an average sample of some 60 pure black teas, give results which serve as a very fair guide. Each sample was boiled for an hour under a vertical condenser, cooled and filtered, and the extract evaporated.

	Per cent.
1 part of tea in 200 parts of water yielded	34·10 of extract.
,, ,, 100 ,, ,, ,,	30·55 ,,
,, ,, 50 ,, ,, ,,	27·55 ,,
,, ,, 20 ,, ,, ,,	22·96 ,,
Exhausted leaves from do. boiled a second time (additional)	8·17 ,,
Do. boiled a third time (additional)	3·75 ,,
,, ,, fourth ,, ,,	1·79 ,,
Total of four boilings of 1 part of tea in 20 parts of water	36·67 ,,

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And even in the last case the tea was not exhausted, for on making fresh experiments I found that 10 grs. of the same sample boiled four times in 3500 grs. of water, each time yielded altogether 39·70 per cent of extract, while 50 grs. boiled four times in the same quantity of water yieided only 35·10 per cent of extract. Other experiments on different samples have confirmed the general character of these figures, though the details differ a little. On considering these facts, I concluded that the most reliable method was to make the 1 per cent infusion, because the results appeared rather more uniform, and there was obviously far less chance of error than when the same sample has to be boiled four or five times. I have therefore adopted it in all the following analyses.

The ash of the extract is generally heavy; in some cases it approaches very nearly to the ash of the original tea, and in exceptional cases even exceeds it. I shall have to speak further on this point when I consider the actual composition of the ash of tea and tea-extract.

The following table shows the amount of extract yielded by twenty-four genuine teas. They are divided into three classes, and arranged in each class according to the percentage of extract yielded :—

EXTRACTS OF TEAS.

No.	Description.	Extract.	Ash of Extract.
	Ordinary Teas (Genuine).		
49.	Gunpowder	39·20	5·75
51.	Hyson	36·80	5·00
52.	Congou	33·00	4·75
41.	„	29·80	—
48.	„	29·80	4·45
43.	„	26·20	4·60
47.	„	26·15	—
	Special Teas (Genuine).		
2.	Moyune young Hyson	44·85	7·00
1.	Indian „	43·85	5·80
11.	Broken Indian	43·43	6·13
4.	Moyune Gunpowder	40·75	5·45
54.	Oolong	40·75	—
57.	Moyune Gunpowder	39·30	4·80
6.	„ „	38·50	4·90
5.	„ „	37·95	5·25
10.	Manuna (fine)	37·00	6·00
17.	Scented Orange Pekoe	34·20	5·40
7.	Moyune Gunpowder	33·35	4·05
55.	Assam	33·30	6·60
21.	Indian Souchong	32·50	5·50
	Capers (Genuine).		
78.	Caper	37·90	4·70
80.	„	37·75	5·15
81.	„	32·40	5·25
79.	„	30·05	4·70

The average of all these results is—extract, 35·79 per cent; ash of extract, 4·63 per cent; while the maximum and minimum extract are 44·85 per cent and 26·15 per cent respectively, or a variation of 52 per cent calculated on the average, and the maximum and minimum ash are 7·00 per cent, and 4·05 per cent respectively, or a variation of nearly 64 per cent calculated on the average.

In ordinary cases of tea analysis I think these determinations of extract are of little value, but they appear to be of use in two special cases. When teas are adulterated with exhausted leaves, the extract will certainly be reduced; thus I found one sample of tea recovered from a sunken vessel yielded only 20·40 per cent of extract, of which 3·08 per cent was chloride of sodium, leaving only 17·32 per cent of nett extract; and another sample of a similar character yielded only 23·29 per cent of extract, of which 1·11 per cent was chloride of sodium, leaving 22·18 per cent nett extract. In both these cases, however, the examination of the ash had already clearly revealed the fact of the tea being partly exhausted.

In some other cases it may be desirable to estimate chemically the value of a sample of tea, and the determination of extractive matter is certainly of service in this case. By careful consideration of the soluble ash—alkali in ash and extractive matter—a tea may be valued almost as closely as by an experienced tea taster. The tables which I have given will illustrate this fact.

The weight of the ash of exhausted leaves is very variable. It averages about 2·50 per cent when the extract has been made on the 1 per cent system, which I recommend, but it is not at all uncommon to find as much as 3·5, or as little as 2 per cent. As a means of judging of the purity of tea, this determination is almost valueless.

(To be continued.)

REGULATIONS FOR INSPECTORS, &c., UNDER THE SALE OF FOOD AND DRUGS ACT.

THE following regulations, the first which have come under our notice, have been adopted by the Plumstead District Board of Works, and we reprint them, as it is possible they may serve as a guide to some appointing bodies who have not yet framed any bye-laws of their own :—

PLUMSTEAD DISTRICT BOARD OF WORKS.

"SALE OF FOOD AND DRUGS ACT, 1875."

Regulations to be observed by Purchasers and Inspectors.

1.—The Inspectors of Weights and Measures are the persons appointed by the Board to procure samples of food and drugs, and to submit them to the Analyst.

2.—The Analyst appointed by the Board is G. W. Wigner, Esq., F.C.S., 79, Great Tower Street, London, E.C.

3.—Any purchaser of any article of food or of any drug in this district shall be entitled to take the same to the Analyst, and on payment to him of the sum of 10s. 6d., and on signing a Declaration in accordance with the form appended hereto, to have the same analysed, and to receive from the Analyst a certificate of the result of his analysis.

4.—Every person purchasing an article for the purpose of having the same analysed shall, after the purchase shall have been completed, notify to the vendor his intention to have the article analysed, and shall offer to divide it into three parts, and (unless the vendor declines his offer) he shall there and then divide the article into three parts, each part of which he shall securely cork in a bottle, seal, and label with the name of the purchaser, the date of purchase, and the name of the vendor. The purchaser shall hand one part back to the vendor, retain one part himself, and take the remaining part to the Analyst.

5.—It will be the duty of the Inspectors to procure samples of food and of drugs, the purity of which the Board, the Analyst, or the Inspector may have reason to suspect, under the direction of the Analyst, and to submit them to the latter officer for analysis. The Analyst will send his certificate to the Board, at their office, at Charlton, when they will consider the same, and, if they think fit, direct legal proceedings to be taken against the seller of the sample, under the provisions of this Act.

6.—An inspector must, after buying and paying for a sample, immediately notify to the person supplying him his intention to take the same to the Public Analyst, for the purpose of having it analysed, and shall offer to divide the sample into three parts, and, if the vendor wishes him to do so, shall divide the sample into three parts, each part of which he will securely cork up in a bottle and seal with his own seal, in such a manner as to render it impossible for the contents of the bottle to be tampered with without the seal being broken. He will then hand one part to the vendor, take another part to the Analyst, and retain the third part himself.

7.—If the vendor does *not* desire to have the sample divided into three parts, the inspector shall take the sample intact to the Analyst, in whose presence it shall be divided, the inspector retaining one part.

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8.—As any vendor refusing to supply an inspector with a reasonable portion of any article of food or of any drug which is on sale by retail, on the proper amount of purchase-money being tendered to him, is liable to a fine of £10, the inspector must, in every case of such refusal, at once report full particulars to the Clerk of the Board.

9.—Each inspector shall keep particulars of all samples purchased, and shall number them consecutively, but the name of the vendor shall not be communicated to the Analyst, whose certificate shall only refer to the sample by its consecutive number or distinguishing mark.

Form of Declaration to be signed by the Purchaser of any Article of Food or of any Drug on his submitting it to the Public Analyst for the purpose of having it Analysed.

"Sale of Food and Drugs Act, 1875."

I, the undersigned,..... of..... declare that on the.....day of.....I purchased the sample of.....which I now hand to G. W. Wigner, Esq., Public Analyst for the Plumstead District, from.....under the name of....., and that I duly informed the vendor of my intention to submit the same for analysis to the above-named Public Analyst, and that in the presence of the said vendor I offered to divide the article purchased into three parts, which offer he did (not) accept, and that I duly sealed and secured the three parts and handed one of the same back to the vendor or his agent, that I desire to have the part which I now hand to the Analyst analysed, to satisfy myself of its purity or otherwise, and that I undertake not to use any certificate I may receive from the Analyst for the purpose of an advertisement.

Dated this.....day of....., 18....

NOTICES OF BOOKS.

A Dictionary of Science, Literature, and Art. Edited by W. T. Brande, D.C.L., F.R.S. L. and E., and the Rev. G. W. Cox, M.A. New Edition, revised. London: Longmans, Green, and Co. 1875.

For an encyclopædia to satisfy all its readers is evidently impossible. No man, as a rule, is satisfied with the share of attention which his favourite subjects have received. Thus it seems to us that in the work before us an excessive amount of space has been devoted to history, language, mythology, theology, law, and the like, and too little to physical science. Perhaps, however, the preponderating attention bestowed upon the former class of subjects will agree with the taste of the general English public, which is certainly not much given to science. It may be supposed by the editors that the brief notices on physical, chemical, and biological subjects will suffice for the ordinary reader, whilst those who wish for more thorough-going information will seek it elsewhere.

Even the space allotted to the physical sciences and their applications might, we think, in some cases have been more judiciously distributed. Thus the canine disease known as "distemper" is discussed at considerably greater length than pulmonary consumption! So-called artificial manures occupy less space than what may be in contradistinction termed natural manures.

The article on Sewage contains not a few questionable statements, and all processes for its purification and utilisation, except irrigation, are quietly ignored. The idea that towns may some day expect to get from a ¼d. to ½d. per ton for their sewage is still maintained. We fear that the prevalence of this notion is one of the causes why so much river-pollution still continues, the municipal bodies still holding back till some company is found kind enough to pay them for the privilege of being allowed to purify their refuse.

The article on Water is somewhat elaborate. We note especially the admission that of the saline impurities the salts of magnesium and calcium are the most objectionable. This is the more important since attempts have been recently made to show that water holding in solution as much as 12½ grs. of anhydrous sulphate of magnesia per gallon—equal, as the reader will remember, to 25 grs. of ordinary Epsom salts—might be safely used as the drinking-supply of a town! One of the Buxton wells, in repute for its gentle purgative properties, contains magnesia equal only to 13 grs. per gallon. This same magnesian contamination, not to be removed by any known process of filtration, is one of the chief objections to the use of the water from Artesian wells.

The important subject Soil is despatched in a dozen lines. The article on the Atmosphere is also brief and unsatisfactory.

We have more especially referred to these heads because they are some of the subjects on which, in these days, men not especially devoted to the study of science may be expected to require correct and moderately full information. We can only regret that these topics have not received an attention more commensurate with that bestowed upon literary subjects. The ability with which the latter have been treated is indisputable, and will doubtless secure for the present edition a continuance of the approval with which the work was formerly received.

The Potato Disease, and the Curl Disease in Potatoes: their Causes and Prevention. By Eccles Haigh. London: G. Philip and Son, Fleet Street.

The author argues that ammoniacal manures have been the prime cause of the potato disease. It appeared, he tells us, just about the time when "high farming" was introduced, while "curl," which he connects with the old, easy-going style of farming, disappeared about the same date. He points out the difficulties attending the fungus theory of the potato rot in a masterly manner. The remedy which he proposes is the avoidance, as far as possible, of highly nitrogenous manures—a recommendation which fully agrees with results very generally, if not universally, obtained.

Wildungen: Its Baths and Mineral Springs. By Dr. A. Stoecker. Translated by C. Harrer, M.D. London: Trübner and Co.

In many parts of the Continent a very lively interest is felt in mineral springs; not merely by resident physicians, hotel-keepers, and other not quite disinterested persons, but by the general public. Half a century ago it was the same in England. From some cause unknown the fashion amongst us became extinct, and now there are few subjects about which an Englishman—be he robust or invalid, scientific or unscientific—cares less than about Brunnen. From a variety of indications, however, it seems as if our national taste for saline and sulphuretted waters were about to experience a revival. The pamphlet before us gives an account of the mineral springs of Wildungen, in the Duchy of Waldeck, and of the diseases in which they are considered to be beneficial.

The Blowpipe: A Guide to its Use in the Determination of Salts and Minerals. By G. W. Plympton. New York: Van Nostrand. London: Trübner and Co.

The attention of American chemists seems to be very prominently turned to the study of the blowpipe and its uses in mineral analysis. In addition to the splendid edition of Plattner, which we had the pleasure of noticing some time ago, two smaller, but yet useful, manuals have made their appearance on the other side of the Atlantic. The work before us, though laying no claims to originality, gives in brief space a large amount of valuable matter. We are much pleased to see that in the table of reactions the rarer metals, capable of detection by the blowpipe, have not been omitted.

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CORRESPONDENCE.

ON RELATIONS AMONG THE ATOMIC WEIGHTS OF THE ELEMENTS WHEN ARRANGED IN THEIR NATURAL ORDER.

To the Editor of the Chemical News.

Sir,—With reference to the remarks made by Mr. C. T. Blanshard, F.C.S., as to the propriety of including two separate equivalent numbers of one and the same elementary body in the table of atomic weights, I may state that, having worked a good deal in this direction, both with the view of filling gaps in the table of atomic weights, and also of rendering their sequence more in accordance with the natural order, I have come to the conclusion that it is much better to keep strictly to the atomic weights alone. Apart from this, it seems reasonable to regard mercurous chloride as Hg_2Cl_2 and cuprous chloride as Cu_2Cl_2, the two metals in these compounds being only *apparently*, and not really, univalent. As a dyad, copper has the atomic weight 63·4, and it is hard to see how Mr. Blanshard makes it twice as great.

The Table I. of "Elements in the Order of Atomic Weight," given in my late paper (Chemical News, vol. xxxii., p. 21), is almost identical with one published by me in the Chemical News, vol. x., p.59, that is, more than eleven years, at which time there was not a single text-book in the language in which the new atomic weights were used. I also then gave a horizontal arrangement of the more important elements, with blanks corresponding to some of the missing members of various groups, and shortly afterwards pointed out the rule, or law, regulating the periodic sequence of the elements when arranged in the natural order of their atomic weights. All this was published and re-published, read before the Chemical Society, and reported in various journals years before M. Mendelejeff had printed anything upon the question. In my new table I have incorporated the atomic weights proposed by M. Mendelejeff for some of the rarer metals, with a few modifications rendered necessary by certain changes in the atomic weights of other elements.—I am, &c.,

John A. R. Newlands, F.C.S.

9, Mincing Lane, E.C., London,
October 4, 1875.

REFORM IN THE MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

Sir,—It may interest your many agricultural readers to learn that the back of an old prejudice regarding the colour of this important manurial salt is now in a fair way of being broken.

Hitherto, almost the whole of the sulphate made for sale for agricultural purposes has been produced from brimstone acid, simply because it cannot be made of a "good grey" from pyrites acid; this conventional stipulation as to colour being regularly made by all purchasers of the article.

Impressed with the absurdity of using brimstone acid for an article destined to go upon the same land as soluble phosphate made from pyrites acid, a large English maker recently offered a consumer with whom he had contracted a reduction of five shillings per ton from his contract price if he would take a darker article made from the cheaper acid, but guaranteed equally rich in ammonia (24 per cent) and equally free from sulphocyanides. The consumer being an intelligent practical chemist and manure maker at once closed with the offer, remarking that he was not particular as to colour so long as the article realised the two essential conditions named.

Another firm have also since taken the darker tinted article at a similar reduction from their contract price.

Agriculturists and manure makers, therefore, who are now paying the present high prices for sulphate would do well to acquaint the parties supplying them that they are prepared to forego the question of tint if this concession in price be made.

It is high time that all such adventitious tests of quality as *colour*, *mechanical condition*, &c., should be discarded by intelligent men. Farmers are rapidly abandoning guano now that its percentage of ammonia is falling, whilst its fine brown colour remains. The colour test is equally worthless in the case of sulphate of ammonia. "Good grey" has been bought by my own firm which, in appearance, was unexceptionable, but which, upon analysis for ammonia, was found to be largely adulterated with white sand.—I am, &c.,

Onward.

PS.—Of course, the consumers of pure *white* sulphate for special purposes in the arts will still be able to get their requirements supplied by manufacturers who make a speciality of the article and require an extra price for it. It is only the "good grey," for manure now made so extensively from brimstone acid which needs to be superseded by the cheaper, but equally guaranteed, make.

REPORT OF THE BRITISH ASSOCIATION COMMITTEE ON THE ESTIMATION OF POTASH AND PHOSPHATES.

To the Editor of the Chemical News.

Sir,—The "Report of the British Association Committee on the Estimation of Potash and Phosphates," contained in your last issue, includes a letter from "a well-known firm of chemists" which has quite astonished my weak nerves. Those "chemists," in declining to give any information upon their methods of analysis, and looking at chemistry, not as a science, but simply as a milch cow, evidently do not at all realise their true position, viz., that they must be prepared at any moment to *justify* their methods before other analytical chemists of recognised standing, which, of course, involves an exact description of their mode of operation. Or, do those gentlemen, whoever they may be, consider themselves as towering so high above the heads of all us poor scientific, analytical, and practical chemists, that we, and the commercial community as a matter of course, must accept their certificates, without questioning, as absolute truth which it is blasphemy to contradict? *Real* chemists need not be told that such pretensions, and the refusal to disclose analytical methods, altogether are utterly irreconcilable with the character of scientific men, and are, in plain words, nothing but the characteristics of people who have every reason to distrust their knowledge and confidence; it matters not whether they have ever so high a standing among chemical brokers and merchants, who are necessarily ignorant of the true qualifications of a chemist.

Pity that Mr. Allen has not published their names, as he would have been fully entitled to do, and that he leaves us to make a guess upon the style of that "well-known firm of chemists, whose results were in some degree the cause of the appointment of the Committee," from the fact of their *not* appearing among his enumerated correspondents. Many of us, in guessing, may not hit far off the mark; but how are chemical merchants, who at present implicitly rely on such people, to find out and brand with deserved scorn the unscientific arrogance of people pretending to belong to a scientific profession? And what good are the labours of the British Association Committee if that "well-known firm of chemists" haughtily despises them, and yet reaps impunity from not being publicly exposed?—I am, &c.,

Chemicus.

October 2, 1875.

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CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Central-Blatt fur Agrikultur Chemie, Heft 6, June, 1875.

Peroxide of Hydrogen in the Atmosphere.—Em. Schöne.—Peroxide of hydrogen, distinguished by its powerful oxidising action, and often confounded with ozone and with nitrous acid, has been detected in rain by Meissner, Schönbein, H. Struve, Werner, Schmidt, and Fr. Goppelsröder; in snow by Struve; and by Houzeau in rain, dew, and snow. The author commenced in the beginning of July, 1874, an investigation on the occurrence of this body—possibly very important for vegetal and animal life—in rain, snow, natural and artificial dew, and hoar frost, having regard to the time of the day and the season of the year, the temperature, the light, the direction of the wind, &c. Rain falling in large drops is richer in peroxide of hydrogen than drizzle. A decrease is perceptible in long continued rain, but in a very irregular proportion. No distinct difference was found between rain accompanied by electric discharges and other rain. The polar current brings rain poorer in this constituent than the equatorial.

Influence of Forests on Atmospheric Moisture and Quantity of Rain.—The absolute quantity of moisture in the atmosphere appears to differ little at any season of the year in open grounds, and in forests. The relative moisture is, however, greater in forests, the difference being greatest in summer, and increasing with the elevation of the place above the sea-level. According to Ebermayer's view, forests increase the amount of rain only by their action upon the relative moisture of the atmosphere.

Action of Vegetation upon the Physical Attributes of the Soil.—Prof. Wollny.—As to the influence of vegetation upon the temperature of the soil, it appears that ground covered with plants is cooler in summer than plots of the same nature lying fallow: in winter the case is reversed. A soil covered with plants is, except in a very shallow stratum, on the surface *poorer* in moisture than similar soil which is bare—a phenomenon due to the great evaporation going on from the surfaces of plants. The fact that a soil covered with plants is looser in its texture than bare soil is explained by the consideration that bare ground is pressed down and puddled by the rain.

Constituents and Physical Properties of Pond Soils.—Dr. A. Hosäus.—Certain of these soils contained —Phosphoric acid, 0·7 to 0·85 per cent; potash, 0·42 to 0·53; and nitrogen 0·04 to 0·06. They may contain more than 50 per cent of water, which they retain very obstinately.

Phosphorites of Samland.—Dr. Hoff Meister.—The deposit is 0·3 to 0·5 metre in thickness, and was noticed in 1870 by Brendt. The amount of phosphoric acid ranges from 35 to 0·32 per cent. Oxide of iron and alumina in some cases reach 11 per cent.

Manurial Experiments with Barley.—Prof. Moschini. —The author has made a series of experiments to decide in how far the action of phosphatic manures depends on the amount of phosphoric acid in a soluble condition. The result showed a heavier crop the richer the manure was in phosphoric acid soluble in water.

"Koprosguano" and various other Manures.—By various French chemists.—Koprosguano is a mixture of various guanos of known composition, containing nitrogen = 3·11 ammonia, and a total of about 15 per cent of phosphoric acid.

The Lime-Salts of the Bones.—C. Aeby and F. Wibel. —Recent bones and recent ivory lose on ignition more carbonic acid than they can take up again on treatment with ammonium carbonate.

Contribution to our knowledge of Vital Changes, and in particular the Process of Respiration of Insects.—O. Bütschli.—In experiments on cockroaches (*Blatta orientalis*) the liberation of carbonic acid was found directly proportional to the temperature.

Recent Investigations on Different Sources of Food for Cattle.

Acclimatisation and Change of Seed.—Professor Haberlandt.—Schübeler maintains that varieties of grain originating in northern countries ripen earlier, and that it is advantageous to take seed from a colder country to a warmer. The author, on the other hand, contends that seed gives better results if grown in a warmer locality than where it is sown.

The Signification of the Decayed Leaves (Streudecke) of Forests, according to their Situation.—Prof. A. Ebermayer.—The total ash decreases with the height above the sea level, especially as regards phosphoric acid.

Influences which determine the Sex of Hemp Plants.—Prof. Haberlandt.

Action of High Temperatures on the Germination of the Seed of Red Clover.—L. Just and Waag.

Germination of Seeds in Nitrous Oxide.—Alfonso Cossa.—Wheat did not germinate in twelve days in an atmosphere of nitrous oxide, whilst similar parcels of grain exposed to air and to oxygen germinated in two days.

Modification of Nitrogen most suitable for the Nutrition of Plants.—Prof. Julius Lehmann.—The experiments undertaken on buckwheat, maize, tobacco, and lupins show that certain plants can utilise nitrogen for their normal development only in the form of nitric acid; others can do this only in the latter period of their growth, and require, in the earlier part of their career, ammonia for vigorous vegetation.

Occurrence of a Diastatic and Peptogenous Ferment in Tares.—E. v. Gorup-Besanez.—See *Ber. Chem. Gesel. Berlin*, 1874, No. 16.

The Place of Fodder-Plants in the Rotation of Crops.

Value of Anthyllis Vulneraria.—Prof. Jul. Kuhn.

A Weed worth Cultivation.—F. Haberlandt.—The author recommends the cultivation of *Saponaria vaccaria*.

Rectification over Burnt Lime.—Bullock.—From *Archiv. der Pharmacie*, 1874, 205, Bd. 11, s. 476.

Examination of French Red Wines for Genuineness of Colour.—Eugen Dietrich.—The red of genuine wines appears brownish in thin layers; if diluted with 50 parts of water its colour is very faint; whilst artificially coloured wines appear decidedly blue-red, even at such a degree of dilution. If diluted with 20 parts by weight of water the behaviour of genuine wines as compared with spurious was as follows:—*Acetate of Lead* 1 : 10.—In genuine wines colour disappears; liquid becomes dirty and turbid. On heating, small silver-grey flakes with a slight reddish tint appear. Spurious wines yield large curdy flakes of a deep violet blue, which on heating becomes more decided. *Sulphate of Copper* 1 : 10.—In genuine wines the colour disappears almost entirely; without turbidity. Spurious wines turn violet-blue, with a slight turbidity. *Baryta Water*, 1 : 10.—Genuine wines lose their colour almost entirely; faint turbidity. Spurious wines turn violet-blue or greenish blue and turbid. Filter-paper steeped in the above tests, and dried, becomes colourless if moistened with genuine wine, whilst coloured sorts give a violet or blue spot.

Investigations on Alcoholic Fermentation.—Dr. O. Brefeld and Wartha.—Not adapted for abstraction.

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M. Reimann's Farber Zeitung, No 35, 1875.

This issue contains an account of the meeting of the Dyers' Association at Berlin. Among other business it was proposed to establish an institution for the theoretical training of practical dyers.

Improvement in the Fermentation Vat.—This improvement, which, though patented, is still kept a secret, consists in a preparation applied to the wool before dyeing, and is said to effect a saving of indigo amounting in some cases to 33 per cent. The prepared wool may be dyed in any kind of vat, including that of Schützenberger and De Lalande.

There are receipts for a fast brown and an olive-green on cotton yarn, an orange for jute, a black for silk garments, magenta, cerise, ponceau, scarlet, lilac, and pansy, for silk rags, and a ponceau for woollen printing.

No. 36, 1875.

The last *canard* on poisonous colours is as follows:—A merchant pared his corns with a penknife. The next day his foot was much swollen, and a medical man called in pronounced him affected with blood-poisoning. The penknife was carefully examined, and on it were found—a few stains of alizarin ink!

No. 37, 1875.

This issue contains an account of a new dye-wor ks a Berlin, and an extract on the subject of poisonous dyes from the *Vossische Zeitung*, according to which certain cotton goods dyed and printed with aniline-violet have been found heavily charged with arsenic. The dangerous articles are of Alsacian origin.

There are also receipts for an orange and blue on calico; for dyeing a light mode grey; a lavender, blue; a greenish mode in two shades; a drab and a reddish mode upon wool and woollen yarns; further, a black and a dark blue for cloth.

NOTES AND QUERIES.

Tar Products.—Can your readers inform me which is the be English work on tar products?—TAR.

Table-Glass Ware.—Can any of your readers favour me with the different quantities of chemicals and other raw materials to be used in the manufacture of fine table-glass ware.—GLASSMAKER.

Purification of Disulphids of Carbon.—Can your readers put me in the way of getting any further information on the subject of the purification of disulphide of carbon by the process described in your last number under the name of Sergius Kern?—R. PAPINEAU.

Society for the Promotion of Scientific Industry—Phosphoric Acid.—Will any readers of the CHEMICAL NEWS kindly oblige me with replies to the following queries:—(1). What is the Society for the Promotion of Scientific Industry? Where are its offices? What is the amount of subscription? Where can its *Journal* be had, and at what price? (2). By what process is phosphoric acid manufactured on a large scale in Germany, and is there any manufactured in England?—AN OLD SUBSCRIBER.

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THE CHEMICAL NEWS.

Vol. XXXII. No. 830.

THE COPPER-ZINC COUPLE AND ITS EFFECTS.*

By J. H. GLADSTONE, Ph.D., F.R.S.,
Fullerian Professor of Chemistry in the Royal Institution.

(Concluded from page 77).

I propose to occupy the remaining half-hour in bringing before you some of the work that has been accomplished by means of the copper-zinc couple. On one of the papers handed to you at the door, I have given what has been done at different dates—the chief results, and the chemistry of the operation, which will be perfectly intelligible to the chemists who are present. You will perceive a note explaining that the copper and zinc are not in any definite chemical relationship or quantity, in the formulæ given.

Let me first take the substance which I have spoken of most fully, that is to say, water. There is one experiment that I should like to show you, because it is so illustrative. Zinc alone put into water does not decompose it. Zinc and copper, as I hope to show you presently, do decompose the water. We can, however, take a metal which does decompose water even at the ordinary temperature. It is very much like zinc, but more

Work done by means of Gladstone and Tribe's Copper-Zinc Couple.

Date.	Chief Results.	Chemistry of Operation.
1872.	Decomposition of water, and preparation of pure hydrogen	$ZnCu + 2H_2O = Cu + Zn_2HO + H_2$
1873.	Direct formation of zinc ethiodide, and	$ZnCu + C_2H_5I = Cu + Zn\{^{C_2H_5}_{I}$
	Preparation of zinc ethyl	$2Zn\{^{C_2H_5}_{I} = Zn\{^{C_2H_5}_{C_2H_5} + ZnI_2$
	Ethyl hydride, and zinc *iodo-ethylate*	$ZnCu + \{^{C_2H_5O}_{H} + \{^{C_2H_5}_{I} = Cu + Zn\{^{C_2H_5O}_{I} + \{^{C_2H_5}_{H}$
1873.	Preparation of di-amyl, ...	$ZnCu + 2\{^{C_5H_{11}}_{I} = Cu + \{^{C_5H_{11}}_{C_5H_{11}} + ZnI_2$
	Zinc amyl, and	$2ZnCu + 2\{^{C_5H_{11}}_{I} = Cu + Zn\{^{C_5H_{11}}_{C_5H_{11}} + ZnI_2$
	Amyl hydride	$ZnCu + \{^{C_2H_5O}_{H} + \{^{C_5H_{11}}_{I} = Cu + Zn\{^{C_2H_5O}_{I} + \{^{C_5H_{11}}_{H}$
	Preparation of methyl hydride	$ZnCu + C_2H_5O + CH_3I = Cu + Zn\{^{C_2H_5O}_{I} + CH_4$
1873.	Preparation of *zinc isopropyl*, ...	$2ZnCu + 2\{^{C_3H_7}_{I} = Cu + Zn\{^{C_3H_7}_{C_3H_7} + ZnI_2$
	Zinc prop-iodide, zinc propyl, and propyl hydride	$ZnCu + \{^{C_3H_7}_{I} = Cu + Zn\{^{C_3H_7}_{I}$ $2Zn\{^{C_3H_7}_{I} = ZnI_2 + Zn\{^{C_3H_7}_{C_3H_7}$ $ZnCu + \{^{C_3H_7}_{I} + \{^{C_2H_5O}_{H} = Cu + Zn\{^{C_2H_5O}_{I} + \{^{C_3H_7}_{H}$
1874.	Isolation of di-allyl, and	$ZnCu + 2\{^{C_3H_5}_{I} = Cu + \{^{C_3H_5}_{C_3H_5} + ZnI_2$
	Preparation of pure propylene	$ZnCu + \{^{C_3H_5}_{I} + \{^{C_2H_5O}_{H} = Cu + Zn\{^{C_2H_5O}_{I} + C_3H_6$
1874.	Preparation of pure olefiant gas and its homologues	$ZnCu + \{^{C_nH_{2n}}_{Br_2} = Cu + ZnBr_2 + C_nH_{2n}$
1874.	Preparation of *zinc ethylobromide*, and	$ZnCu + \{^{C_2H_5}_{Br} = Cu + Zn\{^{C_2H_5}_{Br}$
	Zinc brom-ethylate	$ZnCu + \{^{C_2H_5}_{Br} + \{^{C_2H_5O}_{H} = Cu + Zn\{^{C_2H_5O}_{Br} + \{^{C_2H_5}_{H}$
1874.	Preparation of *zinc chlorethylate*, and direct hydrogenisation of ethylidene	$2ZnCu + \{^{C_2H_4Cl}_{Cl} + 2\{^{C_2H_5O}_{H} = Cu + 2Zn\{^{C_2H_5O}_{Cl} + \{^{C_2H_5}_{H}$
1875.	Complete hydrogenisation of chloroform, and	$3ZnCu + CHCl_3 + 3\{^{C_2H_5O}_{H} = Cu + 3Zn\{^{C_2H_5O}_{Cl} + CH_4$
	Its homologues, and preparation of Acetylene (Investigated by Prof. Thorpe.)	$3ZnCu + 2CHI_3 = Cu + 3ZnI_2 + C_2H_2$
1873.	Conversion of nitrates into ammonia	$4ZnCu + 6H_2O + KNO_3 = Cu + 4ZnH_2O_2 + KHO + NH_3$

The new substances discovered during these investigations are in italics.
Cu signifies simply the metal copper, and not an atomic proportion.

* Verbatim report of a Lecture delivered at the Royal Institution.

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powerful in most of its chemical characters, and it has the power of taking the oxygen away from the hydrogen even under ordinary conditions. We will endeavour to show that by throwing the image on the screen. Here is a vessel of water, and here is a little twisted coil of wire made of the metal magnesium. You will perceive that there are bubbles forming upon the metal. Now the water has got warmer, I dare say, by means of that powerful light behind it; still, though some bubbles are formed, you will perceive that the decomposition of the water is going on but slowly. I will ask Mr. Williams just to put in a little of the blue solution of sulphate of copper which I have here; then you will perceive at once that copper is being deposited upon the magnesium, for the magnesium is growing thicker, and becoming rough with the deposition of metal upon it. Now the bubbles are forming in large quantity. You perceive that the copper and magnesium together are acting energetically upon the water, and the bubbles are forming very rapidly and rising to the surface of the liquid. This little experiment then, I think, will illustrate to you very clearly that the two metals in junction are more powerful than one alone, in decomposing water.

Now we will try the same by means of zinc. Here is a good large copper-zinc couple which has been acting for some time, and here is some of the hydrogen gas which has been collected. You see it is working away slowly at the ordinary temperature. I will ask Mr. Williams to change the water—to pour away this water and take some warm water instead. I have put upon the board the amounts produced at different temperatures, in experiments which were performed carefully. At a temperature of 2° C.—that is to say, only just above the temperature of ice—we got during an hour 1·1 c.c. of hydrogen gas. But when we operated at 22° C.—that is to say, a little above the temperature of this room—we got 5·5, five times as much. When it was made warmer (34° C.) then we had 13·9; when warmer still (55° C.), 62 c.c.; and so on. The quantity of gas increased at a very much more rapid ratio than the increase of temperature; so that when we reach nearly the temperature of boiling water, 93° C., we get about 500 times as much gas produced as when the water was nearly frozen.

This illustrates the effect of temperature. Well, here the action is going on with the warm water. We shall see that the hydrogen gas is coming off more freely than before.

I will ask your attention to this piece of apparatus. It is one which was set up during the Christmas lectures. It was put aside in the laboratory, and I believe has not been touched since. It has been working on during all the time in the cold, and it has been doing its business quietly without stopping. It is still working. Here, in this tube, is an amount of gas which has been collected since yesterday. We have collected these 25 centimetres since about this time yesterday, when the apparatus was placed on the table, and we shall, no doubt, find that this is hydrogen gas. You will observe another result. We have a quantity of white oxide of zinc formed. The zinc has, in fact, turned almost entirely into oxide. We were reckoning just now that it must have given off 4000 c.c. of hydrogen if it went on at the rate that it is going on now; but certainly it has been acting more energetically during the earlier part of these four or five months.

One of Dr. Frankland's greatest discoveries was the discovery of ethyl and of a number of other substances, by acting upon iodide of ethyl by means of zinc at a very high temperature, and at high pressure. In this way he obtained the spontaneously inflammable zinc-ethyl and other bodies. Now we thought that the action which he obtained with difficulty, our zinc-couple would, perhaps, bring about much more readily, and we tried it, and found that such was the case. We have merely to take some of this couple, pour upon it the iodide of zinc, and heat them together, and we find that the iodide of zinc is gradually decomposed — that a solid substance is formed in the reaction, and that this zinc ethiodide, as it is called, and a gas, are produced as Frankland found. If this zinc ethiodide be heated, it is resolved into iodide of zinc and the spontaneously inflammable liquid, zinc-ethyl. We can produce this in larger quantity, and very quickly indeed, by the use of the new copper-zinc couple. However, it is too slow a process for me to show you just now. I will show you simply some ethiodide of zinc which has been produced, and some of the zinc-ethyl which has been prepared in this way. I will take a little up in this tube, and you see as I allow it to pour down from the end of the tube it catches fire the moment it is brought into contact with the atmosphere.

But this couple will decompose a number of other substances of a similar character—iodides and bromides. It will decompose them much more easily than the zinc itself will, and much more quietly, and we can produce substances which we cannot produce without the couple.

I will next show you zinc-propyl—an analogous body never prepared before; but it has been prepared by this means. It is like the zinc-ethyl in some of its properties, and I will repeat the same experiment to you, and show you that it also is spontaneously combustible. Here we have this liquid. As I allow it to run out it catches fire in the air at once, and from the blazing stream rises oxide of zinc, which floats away in the atmosphere. This, then, is one of the children of the copper-zinc couple, and a fiery child it is, as you see.

But we have some more fiery children. The zinc-isopropyl is still more active than that. I must not dwell too long upon these things. We can produce the ethylo-haloid compounds themselves by bringing their constituents together. We can take this zinc-ethyl, for instance, and warm it with iodide of zinc, when it forms Frankland's ethiodide. By using bromide of ethyl instead of iodide, I can produce a perfectly analogous substance. This ethylobromide of zinc we prepared some time ago. This is a substance which was never prepared before, but which was first obtained by means of the copper-zinc couple, and by heating it we can produce our inflammable zinc-ethyl just as from the iodide.

There is no reason why we should not have a chlorine compound like the iodine and the bromine compounds. This has been prepared by means of the copper-zinc couple. My first idea was to prepare it before you in my lecture to-day; but one does not like to make an experiment for the first time in a lecture-room, especially when dealing with such an inflammable substance as zinc-ethyl. One does not know what its behaviour may be when brought into contact with what it has never been in contact with before. This, therefore, was prepared on Saturday, and this is the first and the only specimen of the substance in the world. Here, then, is a new body which has never been seen before except by ourselves. Well, we must give it a name, of course, and what name shall we give it? We can only name it according to the family to which it belongs, and you perceive its brothers upon the printed table. Against the date "1873" we have the direct formation of zinc ethiodide. That was Dr. Frankland's substance. We produced afterwards the zinc ethylo-bromide, and you will perceive that it is put in italics in the table, because it is a new substance. It is this pearly, crystalline body. This last we must call by the same name, putting "chloride" in the place of "bromide." So it stands as the "zinc ethylo-chloride." That must be the name of this new crystalline substance which we have just produced.

It must be remembered that we are only just launching upon this investigation. If, instead of taking the iodide of ethyl and acting upon it by means of the copper-zinc couple, we mix it with some alcohol, or water, beforehand, we get a different kind of reaction. We get the hydrogen of the water, or the hydrogen of the alcohol,

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entering into the matter. That has been going on in this experiment which was started this morning, and I believe that the action has filled this vessel with gas two or three times. In this case the gas is what is called hydride of ethyl. In this other vessel we have a similar substance—hydride of methyl, or marsh gas—the inflammable gas of coal mines, or the inflammable gas which comes off from marshes. It will burn. [The marsh gas was caused to issue from the jar in which it had been collected, and was ignited.]

This is the easiest way, by far, of producing these hydrides; but, at the same time, we are producing something else in the liquid. You who are well acquainted with chemical symbols will observe the chemical equation, and see that it involves the formation of some other body. There is a combination of the zinc and iodine and C_2H_5O. This is a new substance, which we have termed zinc iodo-ethylate. It dissolves in alcohol very freely, but not in water. Here it is. I will show you that it is decomposed by water by pouring a little into the water in this vessel. What we get is a thick precipitate of oxide of zinc and an alcoholic residuum. By similarly treating a bromide, we may get a similar bromine compound, and by similarly treating a chloride, we may get a corresponding chlorine compound. In fact, there are various ways in which these may be produced. I will ask you to look, after the lecture, at this beautiful gelatinous oxide of zinc which is floating about in the liquid.

One hardly knows how to refer to all the various substances that are mentioned in the Table. We will take substances which are perfectly analogous one to the other, as far as composition is concerned. This copper-zinc couple is a quiet means by which we can split them asunder, or, rather, gradually take one element away from the other element; and in this way we can see how they are built up—what we may call their structure. In chloride of ethylene and chloride of ethylidene we have two such bodies, and they are acted upon differently by the couple.

We can produce other bodies by this agency. For instance, here is a specimen of di-allyl. Suppose we take chloroform, or bromoform, or iodoform; we find it easily acted upon. If I were to take iodoform dissolved in alcohol, and put some copper-zinc couple into the vessel, we should see an action taking place, with the production of mixed hydride of methyl and acetylen. This takes a few moments to commence, and then it becomes very energetic in its action. These reactions give about the best illustration that I know of the influence of time. It is very singular that many of them will remain quiescent for a quarter of an hour, or perhaps an hour, without any change being apparent, and then they begin to act, and the action becomes rapid and soon ceases. It is important to be very careful in bringing these substances together in the first instance, because we do not know whether a long time will elapse before the action commences, or whether, as in the case of bromoform, the whole contents of the vessel may be violently thrown out upon the substances being brought together.

Sometimes we are asked the question, "What is the good of these enquiries?" Well, the good is very various. That is generally the last question that we ask in experimenting. It ought to be the last question; but still it is interesting, at least to the public generally, to find that there are some practical results flowing from such investigations. The main results may be of a theoretical order. Our theories, views, or hypotheses, diagrams or illustrations, are all very imperfect. They represent but poorly what takes places in nature. But, by increasing our experiments, and getting more and more to the truth of nature, we advance our theories and improve our knowledge of natural things. It is the same as in higher things, where, I suppose, our first imperfect conceptions gradually become more and more perfect, and we arrive at the knowledge of that which is useful to us, body, soul, and spirit. That may be the usefulness of the copper-zinc couple, as far as theory is concerned; but, as far as practical purposes are concerned, it has already enabled us, as you see, to make at least some half-dozen new substances, which we have now at our disposal. It has also afforded us an easy means of preparing a great number of other substances, such as these hydrides. It has been employed in one way in analysis. One of the most difficult problems in all analysis, but one which is very important too, is the estimation of nitric acid or nitrogenous substances in potable water—for instance, in river water. A great deal has been written on that subject, and Professor Thorpe has employed our copper-zinc couple for turning the nitric acid into ammonia. We have performed the experiment here. This is some of the nitrate of potash which was employed, and here is some ammonia which has been distilled from it after being acted upon; and here is some of what is called the Nessler's test solution. I will show you that this nitrate of potash will not affect the colour of the test in any way; but, if I take a little ammonia, we shall find a very great change. I have not tried whether I have really got any ammonia in this vessel. Yes, we have a quantity of ammonia, formed by the decomposition of that nitre by means of the copper-zinc couple.

I hope that I have been able in this short time to give you some idea of the principle of this copper-zinc couple, and of the work that is being effected in your laboratory by means of it. I trust that the work will go on, and that we may be able to illustrate more fully in this way several principles which I have had so much pleasure in bringing before you during these lectures "On Chemical Force."

ON THE PURIFICATION OF BROWN SULPHATE OF AMMONIA.

By A. ESILMAN.

In the purification of coal gas from sulphur and ammonia there are obtained, as is well known, several products formerly valueless, but now utilised as cheap materials for the manufacture of vitriol and sulphate of ammonia. The principal purifying material is sulphate of protoxide, or hydrated peroxide of iron mixed with a quantity of sawdust, and when this mixture has been properly employed in the purifiers, it leaves the gas-works containing 30 to 60 per cent of sulphur, and sulphate and sulphocyanide of ammonium (mainly the former) in quantity sometimes reaching 20 or 25 per cent. After washing out the ammoniacal salts the residue is burned in peculiarly constructed furnaces for the manufacture of vitriol.

The sulphate of ammonia obtained from the washings by crystallisation is of a more or less dark red-brown colour, owing to the accidental presence of soluble ferric salts in small quantity, and as it contains all the sulphocyanide originally present in the oxide, is of very inferior value in the market. An easy and inexpensive method of converting it into ordinary sulphate was some time ago devised at the works with which I am connected for a neighbouring firm, and has been worked by them ever since. A supply of gas-liquor is necessary, and the "conversion" is carried on simultaneously with the manufacture of ordinary sulphate. The mode of procedure is as follows:—

A quantity of brown sulphate about equal in weight to the acid, which will be only half the ordinary charge, is put into the empty "blower," and then the acid (not less than 110° Tw.) is run in. On turning on steam from the ammonia boilers an effervescent action sets in due to the escape of sulphocyanogen and its products of decomposition, and the result is its speedy volatilisation. This point can be easily shown to be reached by taking out a small portion of the liquor, diluting with cold water, and adding a little solution of ferric chloride or sulphate. No reddening indicates its absence. The contents of the blower are now finished off in the usual way. The only precautions necessary are to

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start with an empty blower, and avoid the addition of water or mother-liquors until the decomposition is completed. Of course the relative proportions of brown sulphate and acid may be varied according to circumstances. When there is a very abundant supply of gas-liquor, more acid and less sulphate may be employed. It is advisable to have a hood over the blower connected with a draught pipe, so as to carry away the deleterious vapours evolved. The cost of the treatment is merely nominal.

That the quantity of sulphocyanide in some samples of commercial sulphate of ammonia is large, may be inferred from the fact that a lot of London sulphate when distilled with slaked lime in excess and the vapours conducted into acid yielded 25 to 27 cwts. white sulphate of ammonia per ton; this apparent paradox being explained by the yield of ammonia produced from the nitrogen of the sulphocyanogen as well as that ready formed. In the absence of soluble oxide of iron such sulphate of ammonia may not show the slightest abnormal colour.

However tempting the presence of cyanogen compounds in products from such exhaustless sources may be to the scientific manufacturer, the present insignificant demand for sulphocyanide salts acts as a complete barrier to their utilisation, and the conversion of sulphocyanide of potassium into the corresponding ferrocyanide by fusion with iron is not such an easy matter on the large scale as laboratory experiments would indicate. Possibly sulphocyanide of barium would give a better result in the desulphurising process, as cyanide of barium is more stable than cyanide of potassium, and is readily converted into potash salt by sulphate of potash.

Manchester, October 8, 1875.

ON THE MANUFACTURE OF EOSINE.

By MM. BINDSCHEDLER and BUSCH,
Basle, Switzerland.

A. W. Hofmann, in his interesting work,* has proved that eosine is derived from the resorcine, *i.e.*, from the fluoresceine, and is especially a combination of tetra-bromine-fluoresceine and potash.

The fabrication of fluoresceine presents no difficulties now-a-days; owing to the splendid works by Bayer and E. Fischer,† an almost theoretical yield and a very pure product are directly obtained by working on a large scale.

The combination of fluoresceine with bromine also yields an almost theoretical result. The technical fabrication of the resorcine alone presented some serious difficulties a sort time ago. The best source for obtaining resorcine was bresiline, which, according to the interesting observations by Professor E. Kopp, of Zurich, produces, by dry distillation, large quantities of nearly chemically pure resorcine.

Upon the advice of his teacher, Professor E. Kopp, Mr. W. Eglé has undertaken, in the laboratories of the Polytechnic Institute at Zurich, a series of experiments tending to prepare benzino-disulphuric acid, from which the melted soda salt, with an excess of caustic soda, produces resorcine.

According to Mr. W. Eglé's method, we have undertaken in our works trials on a large scale, and we have much pleasure in stating that this method‡ is very practical for making that sulpho-conjugated acid, and consequently resorcine.

The transformation of benzine into resorcine, if very carefully operated, is obtained quite easily and with almost theoretical results. Thus the price of the resorcine is relatively very low at present (about 11s. per lb.), and any quantity of resorcine can be got in commerce, while a little time ago this product was very scarce and only to be found in small quantities in the collections of scientific laboratories.

The phthalic acid, which is necessary for the transformation of resorcin into fluoresceine, is also to be had plentifully in commerce (price, about 11s. per lb.). The bromine costs about 1s. 9d. per lb. At these prices of the raw material, eosine can now be produced as cheaply as saffranine, and eosine is already offered below 36s. per lb. possessing a purity and bloom of shade far superior to that which it had on its first appearance.

The fluoresceine is easily combined with bromine, by leaving the bromine to act on fluoresceine, which may either be dissolved in glacial acetic acid or finely divided in water; every drop of bromine disappears immediately, and it is difficult to find the right moment when the action of the bromine must be interrupted. On this circumstance alone depends the success of the operation, *i.e.*, the purity and the splendid colour of the finished eosine. The pure fluoresceine gives to silk a very handsome yellow shade. It is a regular yellow colouring matter. The dyeing is effected in water feebly acidulated with acetic acid, adding thereto by degrees the fluoresceine previously dissolved in water with addition of a small quantity of ammonia. By plunging the silk dyed with fluoresceine in water to which a trace of ammonia has been added, the latter immediately disappears, and the yellow colour of the silk is changed into a red shade, which gets the more body the more bromine is added to the liquor. One arrives slowly at the most bluish shade which can be obtained with eosine. If the action of the bromine continues, the colouring matter begins to be destroyed.

It can be proved by this experiment, which is easily performed, that regulating the reaction of the bromine on the fluoresceine is the most important part in making the eosine. By the same process, any shade can be produced on the same skein of silk, from the pure yellow of the fluoresceine to the most bluish of the eosine.

* *Berliner Berichte*, 1875, p. 62.
† *Moniteur Scientifique*, July, 1875, p. 579.
‡ *Berliner Berichte*, 1875, p. 818.

ON THE MANUFACTURE OF WHITE CAUSTIC SODA.*

By GEORGE E. DAVIS, F.C.S.

(Continued from p. 188).

Section 4.—Concentrating.

The causticised liquor having been obtained, the next stage is its concentration, and as it is extremely dilute, being at the very utmost 20° Tw., the concentration is commenced in steam boilers after the method indicated in Dale's patent, the steam from this being used generally in the causticising process.

Still this method of concentration is only followed by a few, for, owing to the corrosive action of the alkaline solution of sodium sulphide, the boilers are very often under repair, and as any negligence on the part of the workmen is apt to be attended with disastrous results, the process, at one time thought so highly of, has gradually fallen into disuse. Any near approach to the salting point should be most carefully avoided, and it is probably the best plan never to allow the strength of the liquors in the boilers to exceed 30° Tw.

In order to preserve the boilers, it would be much better never to allow liquor to be concentrated in them unless the sulphide has been eliminated, either by means of litharge or by the injection of air.

The liquors are concentrated in pans of wrought- and of cast-iron, and heated by the waste heat of the black-ash furnaces. In some works a cast-iron pan is placed next to the furnace and a wrought-iron one at the end of this, and the weak liquor for concentration is sometimes run into the front and sometimes into the back pan first. In other works they are all of wrought-iron, and where any

* From the *Journal of the Society for the Promotion of Scientific Industry.*

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fishing is done the pans should be boat-shaped to allow of the easy collection of the salts.

Some works, however, prefer all their pans of cast-iron, they being arranged and set according to position and mode of working. These waste heat pans seldom bring up the liquors to the necessary degree of concentration, therefore self-fired pans are sometimes required to finish off.

These may be either of wrought- or cast-iron, but the latter kind are most generally used. They are set singly or in batteries of two and three; if singly, the waste heat passes under a wrought pan to economise the heat; in the other cases the one fire is made to heat the two or three pans in the series.

There are at least two different methods for concentrating the liquors; one by separating the foreign salts in two stages, the other method separates them in one.

Before describing the first method fully, I will just mention a few different plans adopted by manufacturers in dealing with their waste heat from the black-ash furnaces.

In one works each furnace is furnished with a cast-iron pan, with a wrought one at the end of this. The causticised liquor, after having been well settled, is run into the wrought back pan connected with the furnace, where it generally reaches a gravity of about 28° Tw. From this pan it is run into a cast pan, next the furnace, where it will reach a gravity of 50° Tw., or even more than this. Up to this strength no salts will be deposited, and there is nothing more to do but run off the liquor to make room for fresh.

In another works two wrought pans are connected with each furnace, the front pan being placed directly *over* the black-ash furnace so that the black-ash arch is between two fires. This is a very expensive setting, repairs are very heavy, and furnaces often under repair, and this is only compensated for by a very little if any extra evaporation.

The weak liquor is run into the pan over the furnace, where it boils furiously, and is then run into the back pan, where it is always withdrawn below its salting point, just above 50° Tw.

In a third instance each black-ash furnace was supplied with three cast-iron boat pans placed behind each other; the causticised liquor was run into the nearest pan, where it reached a gravity of about 24° Tw.; from this it was run into the centre pan, where it became concentrated to about 54° Tw. No salts were deposited in these two pans; but in the third or back pan the liquor often reached 70° Tw., and salts were obliged to be fished out. The clear liquor, after being allowed a short time to settle, left this series for the pots.

When high gravities are dealt with it is found difficult to do so with an ordinary hydrometer to give good and uniform results, and as the caustic liquors possess a progressive boiling-point as they become more concentrated, it is found better to boil until the contents of the pan arrive at a fixed number. This number varies in different works, but a good heat is 280° F. When the pan is found to boil at this temperature, the fires are mostly drawn or allowed to burn out, and the contents of the pan allowed a short time of repose, in order that the suspended salts may be deposited. The time a pan is allowed to settle will, of course, depend upon the pan capacity of the works; it may vary from less than half an hour to over two hours. The settled liquor in the best regulated works is then run off into settlers, where more salts are deposited, and the pan is run up again with partly concentrated liquor, and the deposited salts fished out; the pan is then fired again, settled, and run off as before.

It may be as well to remark that the concentration as above described is effected by boiling down the strong liquor from the waste heat pans in others which are self fired. They may be cast or wrought. If cast, they are generally fired in batteries of two and three; if of wrought-iron they are fired singly, and each pan is from 26 feet to 30 feet in length.

Some manufacturers prefer to fish out the salts from weak liquors, and in this case there is much less caustic mixed with them. In this mode, after running the pan off, some weak but warm liquor is run upon the deposited salts, when they are fished out, after which the pan is filled up and the boiling re-commenced.

The salts fished from the boat pans consist principally of carbonate and sulphate, the former monohydrated, the latter anhydrous; but when fished from weak liquors both are hydrated crystals. The following are two analyses of these salts. A fished in the ordinary way, B fished from weak liquor.

	A.	B.
Insoluble matter	0·384	0·214
Sodium sulphite	2·734	0·793
,, hyposulphite	0·316	0·252
,, sulphate	29·583	24·499
,, chloride	3·978	1·872
,, silicate	traces	traces
,, aluminate	traces	traces
,, carbonate	27·984	22·684
,, hydrate	15·360	7·680
Water (by diff.)	19 661	42·006
	100·000	100·000

The separation of these salts is strictly a settling process, and the pans when working require watching and chiselling to prevent the incrustation of any of the salts upon the iron; but after the liquor has left the pans and has been run into the settlers, the next batch of salts in these settlers is separated by the cooling of the liquors, essentially a crystallisation process, and these salts are principally sodium chloride, containing also carbonate and sulphate in lesser quantity. The following are two analyses of these salts:—

	A.	B.
Insoluble (chiefly FeS)	1·143	0·867
Sodium sulphide	traces	0·077
,, sulphite	2·734	1·013
,, hyposulphite	0·316	0·146
,, sulphate	9·768	5·772
,, chloride	37·674	60·443
,, silicate	traces	traces
,, aluminate	traces	traces
,, carbonate	15·052	5·683
,, hydrate	13·440	10·773
Water	19·873	15·226
	100·000	100·000

The liquor, after having been boiled to 280° F., and the two descriptions of salts separated, is now ready for the caustic pots, where it may be boiled down and fused direct if only for 60 per cent caustic; but if 70 per cent is required it must be concentrated further to separate another batch of salts, which have nearly the same composition as the last. As, however, I intend to speak of the finishing as starting from the liquors boiled to 280° F., I will leave the further concentration for 70 per cent to be described in Section 5.

In some works nitrate of soda is added to the liquor in the boat pans to "throw down" the salts as it is commonly expressed, care being taken, however, that always a deficiency is used, as any excess here means so much lost by separation with the salts. If the liquors have been thoroughly oxidised during causticising, no nitre is necessary here, for even if the liquors possess a red tinge and contain some sodium sulphide, still the quantity is too small to admit of the use of nitre.

Muspratt, in his work, gave the formulæ for the reactions which he supposed took place when sodium nitrate was digested at high temperatures with sodium sulphide and hyposulphite; and Dr. Pauli, in 1862, it is stated, studied the action of nitrate of soda upon sodium sulphide. He stated that so long as the boiling-point of the liquid was between 280°—290° F., the sulphide is quietly oxidised to sulphate, sodium nitrate being formed. Now below

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280° F. ammonia is evolved, and but little sulphite is produced, so if this reaction takes place at all (and we should expect a nitrate in an alkaline solution and in the presence of such reducing agents to be thus acted upon) it must be at a much lower temperature than 280° F.

My researches upon this subject have led me to a very different conclusion, viz., that the oxidation of sodium sulphide to the state of sulphate takes place in three distinct stages; first, from sulphide to hyposulphite, then to sulphite, and lastly to sulphate.

The reactions being—

(1) $2Na_2S+NaNO_3+3H_2O=Na_2S_2O_3+3NaHO+NH_3$.

(2) $2Na_2S_2O_3+3NaHO+NaNO_3=4Na_2SO_3+NH_3$.

(3) $5Na_2SO_3+2NaNO_3+H_2O=5Na_2SO_4+2NaHO+N_2$.

The first reaction takes place below or about 280° F., and the hyposulphite remains for the most part in the liquor; the second commences about 305° F., a little above or below, and the sulphite of sodium which results rises and floats upon the top of the pots as a white scum. When the last reaction commences it would be difficult to say, but in most cases the evolution of ammonia stops at 360° F., and the nitrogen is then evolved in its place.

All these reactions cannot occur unless an excess of nitre has been added to the liquors, and even without the addition of nitre, sulphite is formed at a temperature of about 320° F., probably owing to the action of the air upon the hyposulphite, thus:—

$$Na_2S_2O_3+2NaHO+O_2=2Na_2SO_3+H_2O.$$

When a high temperature is reached, and even by contact of the liquors with the heated pans, some of the hyposulphite is decomposed after the following reaction:—

$$Na_2S_2O_3+2NaHO=Na_2SO_4+Na_2S+H_2O.$$

Some sulphide gets completely destroyed by the oxidising agency of the atmosphere, and in cases where the liquors have been completely oxidised during causticising, some pots have been finished without a particle of nitre ever going into them or into the liquors in any stage. When nitrate of soda is added to the liquors to be boiled to 280° F., ammonia is evolved and hyposulphite formed, which remains dissolved less the small quantity accidentally decomposed to sulphite, which falls with the salts and may be seen in the preceding analysis.

If nitrate of soda then is added to the pans it should be added in quantity according to the first equation. I have considered this reaction proved by the fact that when nitrate of soda was added to the liquor in a pan in quantity indicated by equation (1), and then boiled to 280° F., 90 per cent of the sulphide was oxidised, while a very small proportion only should have been oxidised if the reduction took place only to nitrite, and sulphate formed.

When the oxidation by means of nitre is effected at the fusion-point of the caustic soda, the reaction is probably not that indicated by Pauli:—

$$5Na_2S+8NaNO_3+4H_2O=8NaHO+5Na_2SO_4+8N;$$

for it must be remembered that the caustic in this stage is in the state of igneous fusion, and no water is present but that which is chemically combined with the sodium oxide. The first method of concentrating or separating the salts in two stages having been described, I will now turn my attention to the process where all the foreign salts are separated in one operation. In this method the weak liquors are concentrated in the two pans at the end of the black-ash furnace, where it reaches a gravity of about 50° Tw. This is only a few degrees short of its salting-point; no fishing is therefore done in these pans, and if through bad setting the pans cannot boil to this strength, it must be made to reach this gravity in self-fired pans. Without any settling it is run into pans in the caustic shed, and fed into caustic pots of the ordinary size and shape, and there boiled until it reaches 280° F., when the fires are drawn and the contents of the pot allowed to settle. The sulphate, carbonate, and chloride, with several other salts, are deposited here and in one operation, and the supernatant liquor baled off, where it is treated as described in the next section. Weak liquor is then run upon the deposited salts, which are fished out, allowed to drain, and sent into the black-ash mixing. The following are two analyses of these salts:—

	A.	B.
Insoluble matter (chiefly FeS)	0·742	1·004
Sodium sulphide	0·116	0·097
„ hyposulphite	0·274	0·718
„ sulphite	3·723	2·695
„ chloride	7·024	5·834
„ sulphate	22·773	26·432
„ silicate	traces	traces
„ aluminate	traces	traces
„ carbonate	21·559	24·218
„ hydrate	8·417	10·116
Water (by diff.)	35·372	28·886
	100·000	100·000

Of these two methods it is doubtful to say which is the better of the two: the expenses of the first are a maximum of labour and repairs, while in the latter method the maximum expense is fuel; but the fuel expense is about equal to that of labour and repairs, therefore it remains an open question which is the best process to adopt?

I will now conclude this section by giving two analyses of the concentrated liquors running into the pots:—

	A.	B.
Iron sulphide	0·740	none
„ peroxide	none	0·071
Sodium bisulphide	0·462	none
„ sulphide	0·531	none
„ sulphite	none	none
„ hyposulphite	12·324	19·908
„ sulphate	2·964	0·120
„ chloride	19·890	26·325
„ silicate	1·758	1·555
„ aluminate	6·984	5·784
„ carbonate	25·840	22·506
„ hydrate	552·000	560·000
„ sulphocyanide	0·342	1·240
Total solids per litre	623·835	637·509

A is from liquor thoroughly oxidised during causticising, boiled down to 280° F.; it was 93° Tw. at 52° F.

B is from liquor not oxidised, but nitre added in boat pans and boiled to 280° F.; at 52° F. it was 96° Tw.

This liquor should be examined once a day; analyses of these when kept from day to day often come in very useful. The examinations would probably be best kept in the following form:—

Date.	Deg. Tw.	Deg. F.	Total Na_2O.	Caustic Na_2O.	Na_2S.	NaCl.

(To be continued.)

REPORT ON

THE METHODS EMPLOYED IN THE ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS, AND ON THE MODE OF STATING THE RESULTS.*

(Continued from page 172.)

Estimation of Potash.

The Committee has received comparatively few replies on the estimation of potash in commercial salts containing it, on account of the limited number of chemists having special experience in its determination. The answers

* Presented to the British Association, Bristol meeting. Report of a Committee of Section B, consisting of E. C. C. Stanford, Chairman; James Dewar; Alfred E. Fletcher; and Alfred H. Allen, Hon. Secretary.

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received are, however, from chemists of the first rank as authorities on the subject, and the communications appear to be almost exhaustive of the question.

The method of estimation by platinic chloride is employed by all the chemists who have communicated their processes to the Committee, the only differences being in the manipulation and details of the method.

Some chemists recommend the removal of any sulphates by addition of a slight excess of chloride of barium, and some also remove any calcium or magnesium which may be present.

The Committee is in possession of some correspondence respecting a sample of "muriate" which was analysed independently by Prof. Fresenius and Mr. R. Tatlock, and as it throws much light on the origin of the discrepancies often observed in the estimation of potash, the Committee quotes it almost *in extenso*, together with a description of the methods employed by the two authorities above referred to.

Messrs. Wallace, Tatlock, and Clark write:—"We employ the platinic chloride method as described by Fresenius in the sixth edition of his "Quantitative Analysis," with a slight modification, which renders it more applicable to all the numerous varieties as well as strengths of commercial potash salts. In estimating the potassium in the latter the following is the method we employ:—

"After pounding and mixing in the usual way, a quantity of the salt (500 grains) is weighed out and dissolved in hot water, and filtered. The filtrate and washings, being cooled to the normal temperature, are mixed well, made up with water to a fixed bulk (5000 grains), and again mixed. A portion of the solution (100 vol. grains), equal to 10 grains of the original sample, is delivered into a small basin, diluted with 400 grains or so of water, and acidified slightly with hydrochloric acid. About 500 grains of platinic chloride solution (containing at least 25 grains of platinum) are added, the fluid evaporated nearly to dryness on the water-bath. A few drops of water are then added to the residue, and the evaporation repeated to expel the excess of hydrochloric acid. About fifty grains more of the strong platinic solution are mixed with the precipitate, and the whole stirred well, and set aside in a cold place for at least an hour with occasional stirring; the precipitate is then thrown on a very small filter (unweighed), the basin rinsed out with about 10 drops more of the platinum solution, and the precipitate on the filter washed with 10 or 15 drops more. The basin and the filter and contents are then washed with the smallest possible quantity of alcohol at 95 per cent strength, and dried at 100° C. The dried precipitate is transferred as completely as possible to a small capsule, in which it is further dried until it assumes a distinct orange colour, and weighed. The filter with trace of adhering precipitate is ignited on a crucible lid, and the residual metal, with its corresponding chloride of potassium, calculated to potassio-platinic chloride, and the weight added to that of the precipitate.

"The following factors are employed:—To bring the precipitate to potassium, 0·1603; to potash, 0·1930; and to chloride of potassium, 0·3056. These figures are based on Stas's numbers for potassium and chlorine, and Berzelius's equivalent for potassium."

Dr. Fresenius writes:—"I am quite ready to go once more closely into the question regarding the estimation of potassium in commercial potash salts. However, I can only do so occasionally when I am at leisure, for there are a great many experiments still to be made before being able to give a satisfactory answer. As far as I am concerned myself, as well as the analysis in my laboratory, these questions are of no great importance. The great object I have in view is to be accurate; saving time is only a secondary consideration. I begin by entirely separating from the solution the sulphuric acid, lime, and magnesia; then I weigh the pure chloride of the alkali metals, estimate the potassium as platino-chloride of potassium according to the method given in my "Manual of Quantitative Analysis," make sure that it is quite pure, and generally also estimate, the chloride of sodium in the washings by evaporating and heating the residue in a current of hydrogen,* partly to have a check, principally, however, to make sure that it contains no more potassium. This method, however, is not practicable in works because it is too elaborate."

In reference to the estimation of potash, Messrs. Wallace, Tatlock, and Clark also write:—

"It is a notorious fact that while the results obtained by the process we follow as compared with those got by what we may term the alcohol method agree very closely in the case of potassium compounds free from sodium, wide differences have been observed when the potassium salts were of low strength from the presence of sodium compounds. To this fact it would not be difficult to get manufacturers and merchants to testify. This remark applies specially to the case of potassium products from kelp, of which many thousand tons are made in Glasgow every year, some of which contain a large proportion of sodium sulphate, which is not readily convertible into sodio-platinic chloride, but must be converted into chloride by double decomposition with barium chloride,—a tedious and unnecessary process, and one liable to lead to error in any than very skilled hands. Sulphate of potash made from kelp is an excellent example of this kind of salt, as it usually contains about 20 per cent of sodium sulphate in the form of the double salt, $3K_2SO_4+Na_2SO_4$.

"It was with the view of obtaining a process for the estimation of potassium directly in these compounds that the process we employ was originated, and it has stood the test of practice for fifteen years. It has been objected to our process that the potassio-platinic chloride is soluble to an appreciable extent in platinic chloride solution; but our experience goes to show that in the circumstances of a potassium determination as above described the results obtained are accurate. As an instance of this we may mention that a German firm, supposing that we must necessarily get too low results, handed to us for analysis, in the usual commercial way, a sample of muriate of potash. We found and reported, as the result of the only trial made, 99·95 per cent of chloride of potassium, and were informed afterwards that the sample consisted of pure chloride of potassium, prepared and sent in order to test our process. A further instance will suffice to show the exactness of this mode of estimating potassium in presence of sodium compounds in quantity. A portion of a carefully mixed and pounded sample of muriate of potash, of which we had made previously a complete analysis as usual by this method, was forwarded by our client to Dr. Fresenius unknown to us, with the request that he would spare no pains to arrive at the truth regarding the relative proportion of potassium and sodium salts which it contained. The following are the results of the respective analyses:—

	W. T. and C. Per cent.	Fresenius. Per cent.
Chloride of potassium	88·50	88·86
Sulphate of potash..	0·13	—
Chloride of sodium	8·46	8·39
Sulphate of lime	0·18	0·22
Chloride of magnesium..	0·50	0·47
Insoluble	0·23	0·23
Water	1·80	1·83
	99·80	100·00
Potash	55·97	56·10
Equal to chloride of potassium ..	88·65	88·86."

With reference to Mr. Tatlock's method and the above analyses Dr. Fresenius writes:—

* How the proportion of chloride of sodium present is deduced from the weight of the ignited residue is not stated: probably by washing with water, and subtracting the weight of the residual metallic platinum.

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"I must object to his washing the precipitate with chloride of platinum. He dissolves by doing so a small quantity of chloride of platinum and potassium, and you see that he makes the chloride of potassium 0·21 per cent lower than I. The discrepancy, however, will scarcely ever be greater. To make sure not to keep any chloride of sodium along with the chloride of platinum and potassium, I first extract the chloride of platinum and sodium with spirits of wine of 80°, and then wash the chloride of platinum and potassium with a few c.c. water, drop by drop; then I evaporate this solution, adding a little chloride of platinum, treat the small precipitate again with spirits of wine, and add the small quantity of chloride of platinum and potassium to the bulk."

In reply to the above criticism the Glasgow Chemists say:—"In his analysis of this sample Dr. Fresenius followed the method described in the sixth edition of his "Quantititave Analysis;" but, evidently fearing that the digestion of the precipitate with alcohol of even 80 per cent might not free it from sodium compounds, he used a little water, wherewith to ensure the separation of the latter, and afterwards estimated the potassium in the washings obtained, adding this to the main result—a plan which of course can be equally adopted with our process if considered necessary."*

Messrs. Wallace, Tatlock, and Clark further write:—"Our method obviates the necessity of converting sulphates into chloride before applying the platinum process. All that is necessary in the case of these salts, or where they are present, is to add an equivalent quantity, or rather more, of pure sodium chloride, which takes up the liberated sulphuric acid. We believe that the general tendency is to report potassium results too high, not only on account of incomplete removal of sodium compounds from the potassium precipitate, but by reason of impure platinic solutions, which, however pure when originally made from the metal, are liable to contamination through the spent liquors and precipitates being recovered by questionable means. There is almost no limit to the accuracy of this process with care, and in good hands the potash may be estimated easily to within 0·05 per cent."

Mr. W. Galbraith, who has had great experience in the analysis of potash salts by Mr. Tatlock's method, writes as follows:—"The method requires a few precautions, the principal of which are that the pipette be accurate, and that the platinic chloride be pure. Care, too, should be taken that the evaporation should not go to dryness, especially in presence of a large quantity of soda salts, as otherwise the result will be too high. By diluting the solution previous to the evaporation the precipitate comes down in larger crystals, and is more easily filtered and taken off the filter, and is also more likely to be pure. With these precautions, which are easily attended to, the method gives rigidly accurate results, even in the hands of inexperienced manipulators."

Dr. G. L. Ulex, of Hamburg, separates any sulphates by very cautious addition of chloride of barium. He washes the chloro-platinate of potassium with alcohol of 80 per cent. He obtains results reliable to within 0·2 per cent. The process, "although simple, requires to be worked carefully, otherwise serious mistakes will be made."

Mr. M. J. Lansdell says:—"I consider the great secret is to use plenty of platinum, which facilitates the washing out of the sodium salt, and renders the indication by colour (as to when to arrest washing) distinct."

M. Joulie separates sulphates, and then the barium introduced, together with any calcium or magnesium present. He washes the chloro-platinate with a mixture of alcohol and ether. "Absolutely exact results are obtained in five or six hours, whatever the nature of the original sample."

Dr. G. Berrand uses a large excess of platinic chloride, and washes the precipitate with alcohol of 98 per cent. He removes any sulphates with a slight excess of chloride of barium. He remarks that "the most essential point of the whole method is the purity of the chlorate of platinum, which can be well proved by testing it with chemically pure muriate of potash. This, of course, must yield 100 per cent: if more or less, the platinum solution has not been pure. If the platinum solution is correct, even less practiced hands will obtain exact results by the above method, which now is universally applied in the manufactories of our place."

The above replies and correspondence show conclusively the necessity for independent experiments on *mixtures* containing known amounts of real potash.

(To be continued.)

* As the quantity of solution of platinic chloride solution employed by Mr. Tatlock for washing the precipitate does not exceed 70 fluid drachms, the solution of any sensible quantity of the latter seems improbable, and, if occurring, might be altogether prevented by previously saturating the platinic chloride with the potassium salt.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 185.)

As the "système Leprince," or "gas mixte Leprince," it was introduced into industrial concerns at Liege, adopted by the town of Mastricht, and by some departments of the Vieille Montagne at Verviers, and was critically described by Verver in 1848 in his work above quoted. Four years afterwards a similar procedure was elaborated by Baldamus and Grüne,† for which Schäffer and Walcker obtained a patent in Prussia. Their process consisted in passing steam through retorts in which coal-shales, turf, and other combustibles were heated to redness. It differs, therefore, from White's process herein that the production of hydrogen and its carburation are effected in the same retort. An ordinary gas retort 8½ feet in length is said to yield, in twenty-four hours, 8000 to 9000 cubic feet of this gas; and in Wagemann's manufactory at Benel, near Bonn, where this process has been introduced, 1 cwt. of coal-shale was consumed per 1000 cubic feet of gas.

Essentially different is the second method of employing hydrogen for lighting, as carried out in 1846 by Gillard, at Passy, near Paris. He fixed on the burners,‡ from which the water-gas issued, baskets of platinum wire, which, on the ignition of the gas, were heated to brilliant whiteness. Hence it was called platinum gas (*gaz platine*). The immobility of the light, even in a strong wind, the dispensing with lamp-glasses, which, according to Verver, absorb 22 per cent of the light, and the brilliance obtained on this principle, must be considered as advantages, although the intensity is not free from objections. Its use was not continued at Passy, but it was introduced by the celebrated firm of Christofle and Co. into their electro-plating works at Paris,‖ and was employed to light the streets of Narbonne. The hourly consumption of gas being 3·234 cubic feet (=0·1 cubic metre), the light was equal to that of 5·22 normal candles, and, though the lamps at Narbonne were placed at intervals of 50 metres, Verver pronounced the lighting of the streets as perfect.

Latterly, since the preparation of hydrogen has been improved by Tessié du Motay and Maréchal, new attempts have been made in Paris to light up large squares and streets with "platinum gas." Spectators, however, may find justification for the caricatures in the Parisian comic journals of that time, which represent the passengers in the streets, and even infants in arms, and the very dogs in

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† *Journal für Gasbeleuchtung*, 1862, p. 63.

‡ Report by O. Henry, *Journ. Pharmacie* [3], xvii., 205; *Dingler's Journal*, cxvi., 222; and the Reports of Bromeis and Verver.

‖ Wagner, "Handbuch der Technologie," 1873, ii., 371.

the gutters, equipped with eye-shades to preserve their sight.

Technical literature has the peculiarity that it records the introduction of novelties, dut leaves us in the dark concerning their practical verification. It keeps a tolerably exact register of the births of inventions, but gives a very imperfect account of their career in life and of their deaths. Thus, with a single exception, we are left in the dark as to the permanent results of lighting with hydrogen.

The experiments made with water-gas at the town Elisabeth, in New Jersey, yielded unsatisfactory results, as made known in 1865.§ Great depreciation of plant, heavy working expenses, and disproportionate consumption of fuel were the causes of failure.

It was, therefore, the more desirable to ascertain in how far the process had proved successful in Europe, and, thanks to the kindness of several correspondents, we have succeeded in obtaining information. The fate of the method in Belgium appears from an extract from a letter which M. L. de Koninck, Professor of Chemistry at the University of Liege, kindly forwarded to the present writer:—

The *système Leprince*, which consists in the introduction of small quantities of water into the retorts in which coal is distilled, had for a short time a certain success (*une certaine vogue*), depending mainly on numerous reclamations by which it was helped out. Its chief advantage was supposed to lie in the fact that it drove the gas out of the retort, a purpose for which an exhauster or aspirator is now preferred. The system has never been employed for public purposes in Belgium, but merely in certain manufactories. Since the death of the inventor, which took place some years ago, it is no longer spoken of, and has been generally, if not universally, abandoned. This has been the case at Vieille-Montagne.

(To be continued.)

§ Wagner, *Jahresberichte*, 1865, 758.

SOCIETY OF PUBLIC ANALYSTS.

THE following instructions have recently been issued by "The National Chamber of Trade," for the guidance of retail dealers. They appear to be drawn up with considerable care, and will no doubt be carefully studied by the class for which they are intended. In any prosecution under the new Act it cannot, at any rate, be urged that the tradesmen have been taken at a disadvantage. It is, however, to be hoped that the inspectors charged with the duty of procuring samples will take care that they are at least as conversant with the provisions of the Act as the shopkeepers may now be fairly supposed to be.

"THE SALE OF FOOD AND DRUGS ACT."

Instructions for the Guidance of Retail Traders.

The term "food includes every article of food or drink, excepting "drugs" and "water."

The term "drugs" includes medicine for internal or external use.

On and after October 1st, 1875, no trader can be convicted (under the 3rd, 4th, and 5th sections) of selling an adulterated article if he can show, to the satisfaction of the Justice or Court, *that he could not with reasonable diligence* have ascertained that the article sold by him was mixed, coloured, stained, or powdered, so as to render the article injurious to health, nor (under the 6th section) if he can also show that it is a recognised article of commerce, or a proprietary medicine, or a compounded drug, or that the extraneous matter was unavoidably due to the process of collection or preparation.

A *verbal declaration* is not *now* required, but retail traders must, upon delivery to the purchaser, affix, or see that in the case of all mixed articles there is a legibly or distinctly written or printed label on the packet, parcel, or vessel, to the effect that the article is "MIXED."

To abstract from an article any part thereof so as to affect injuriously its quality, *without notice to the purchaser*, will render the vendor liable to a heavy penalty.

Retail traders are advised to obtain *a written warranty* in every case where it is possible.

The purchase of articles for analysis is not limited to officers appointed for the execution of the Act, but it appears that no penalty would be incurred by refusing to sell for that purpose to a private individual.

After the completion of the purchase of an article for analysis *the purchaser must forthwith notify* his intention to the seller or his agent.

The trader must, upon the tender of the price of any article exposed for sale by an officer, inspector, or constable charged with the execution of this Act, sell him the same, under a penalty not exceeding £10.

Precautions to be observed at the Time of Sale.—

1. The purchaser, for the intention of analysis, must then and there offer to divide the article, in the presence of the seller or his agent, into THREE parts.
2. *If required to do so* the purchaser must then and there mark, seal, and fasten up each part, according to the nature of the article, and deliver one part to the seller or his agent,

Note.—Insist upon the article left in your possession being then and there sealed with the *Inspector's seal*, and put the article under lock and key in the event of it being required for future comparison or analysis.

A notice should be given, by the first post after an article has been sold for analysis, to any prior dealer or wholesale house whom it is intended to hold responsible for the result without waiting for the issue.

In the event of the Trader being summoned:—

1. The certificate of the analyst is sufficient evidence with the production of the part of the article retained by the purchaser.
2. The certificate of the analyst must be in the form of the Schedule, or to the like effect.
3. The defendant can require the analyst to be called as a witness by giving due notice to the prosecutor *immediately on receipt of the summons*, and can also tender himself and his wife to be examined on his behalf.

   N.B.—The defendant should always be prepared to do this.
4. If the defendant be not satisfied with the certificate of the analyst he can request the Justice or Court of Appeal to submit the sample in his or the purchaser's possession to be examined by the Government Analytical Officers at Somerset House.

   N.B.—In case of a refusal by the Justice or Court of Appeal the defendant can give notice of procedure by Mandamus in the Court of Queen's Bench.
5. The defendant cannot claim to be discharged from his summons unless he shall have given due notice to the prosecutor that he will rely on the defence described in the 25th Section.

With regard to Appeal and Defence:—

The defendant has the right of appeal, but must give notice accordingly, and may recover penalties and costs, in addition to any other damages, if he be able to prove—

1. That he sold the article in the same state that he received it, and had no reason to believe it to be otherwise.
2. That he can produce a written warranty.
3. That he could not, with reasonable diligence, have ascertained that the article was mixed, coloured, stained, or powdered, so as to be injurious to health.
4. And that the conviction was wrongful and the claim not unreasonable.

(A direct appeal to the Court of Queen's Bench is advised in preference to the Quarter Sessions.)

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On and after the 1st January, 1876, all imported tea will be examined by the Customs.

The Adulteration Acts are repealed.

Special arrangements have been made for sending samples for analysis through the Post-Office.

OBITUARY.

Dr. ROBERT SCHENK, F.C.S.

We regret to record the death of Dr. Robert Schenk, F.C.S., of Brixton, a gentleman well known as a scientific chemist and teacher.

Dr. Schenk was one of the original abstractors of the Chemical Society, in which capacity he worked hard to the last, and was the author of some useful chemical work. In spite of a constitution sadly enfeebled by long illness he prosecuted his researches under the most adverse circumstances until his death, which occurred suddenly at Epsom, on September 13, at the early age of thirty-seven.

The real worker in science has often to toil hard and long ere he gathers the harvest.. In the case of Dr. Schenk it may be said that the seed had been sown and was fast ripening, when the sower was stricken and his earthly hopes blighted. Under these circumstances a professional brother leaves a widow and child almost entirely unprovided for, and it has been thought by some of his friends to be their duty to make this known in the hope and assurance that something will be done to assist the loved ones whom he has left behind.

Subscriptions for this object will be gladly received by—John Newlands, 9, Mincing Lane, E.C.; Alfred Tribe, Dulwich College, S.E.; Arthur Vacher, 20, Great Marlborough Street, W.; or by Professor Gladstone, Royal Institution, who has kindly consented to act as Treasurer.

CORRESPONDENCE.

REPORT OF THE BRITISH ASSOCIATION COMMITTEE ON THE ESTIMATION OF POTASH AND PHOSPHATES.

To the Editor of the Chemical News.

Sir,—The least that we could have expected of Mr. Allen was that he should have also published the list of those analytical chemists who have *not* replied to his circular. It strikes me such a list would be found to contain many well-known names, and that he need not in this case have gone abroad to get such names as Fresenius to give it respectability.

There is no hiding the fact that this Phosphate-Potash Committee is a total failure, and that the vague and unsatisfactory discussion of processes now occupying much space in your exceedingly valuable journal will not prove of much service either to chemists or manufacturers. There are standard works on analytical chemistry in three or four languages, and dating almost up to the present hour—persons interested can see there "how it's done," or how it ought to be done. If Mr. Allen could kindly show us how we can raise our fees, so that an analytical chemist may have some chance of competing with an engineer or a medical man, we shall all be much obliged to him.

Having been myself in constant practice for nearly twenty years, I have, perhaps, some little right to give my views of the subject, the more so as I am personally unacquainted with Mr. Allen and the learned members of his Committee. I enclose my card.—I am, &c.,

EQUIVALENT.

London, October 15, 1875.

PS.—"Brokers and merchants" show wonderful tact in discovering the most trustworthy analytical chemists. "Chemicus" need have no fear on that score.

MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

Sir,—I don't think "Onward" can be acquainted with the manufacture of sulphate of ammonia, or he would know that "good grey" can be made from pyrites acid quite as well as from brimstone acid. I have myself during the last ten years used acid made from brimstone, Norwegian, Westphalian, coast, and also coal pyrites; in the latter case the acid was almost *black*. I must say I cannot see any difference in the appearance of the sulphate; the colour arises from quite another cause—at least, that is my experience.—I am, &c.,

E. H.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 13, September 27, 1875.

Twelfth Note on the Electric Conductivity of Bodies of Medium Conducting Power.—M. Th. du Moncel.—The author gives the following conclusions as resulting from his experiments:—1. Metallic ores, when they have a certain degree of conductivity, generally produce under the influence of heat thermo-electric effects, and this thermic influence increases or lessens the conductive power of the ore according as its resistance is greater or smaller. 2. Certain metallic ores may present the electro-static and electro-tonic effects so remarkable in hard stones, especially of a siliceous kind; but they join to these effects those resulting from the thermo-electric action, and when these two effects occur simultaneously the latter generally predominate. In all cases these ores are not affected by the moisture of the air. 3. The ores which are in the condition in question are relatively resistant, yet less so than ordinary stones, and, in consequence, heat augments their conductibility. 4. The ores which present a great metallic resistance, and which have not a well developed electro-static capacity, possess a very feeble metallic conductibility, but do not determine sensible thermo-electric currents, and heat slightly augments their conductibility. 5. Ores which only possess a highly-developed metallic conductibility produce intense thermo-electric effects, but heat decreases their conductibility, and the effects which are the consequence of electro-tonic conductibility are not there met with.

Transformation of Blood into a Soluble Powder, and the Chemical, Physical, and Alimentary (!) Properties of this Powder.—M. G. Le Bon.—The author does not describe his process further than by saying that he "operates at a low pressure, and at temperatures not exceeding that of the human body." His preparation is designed for food, and he states that in "England, Sweden, and Russia various aliments have recently been made with liquid blood, especially for the army; and that the results, in a hygienic point of view, have been excellent."

Putrefaction Produced by Bacteria in Presence of Alkaline Nitrates.—M. Meusel.—The author concludes that the presence of nitrites in ordinary water is due to the presence of bacteria when the water contains nitrates and organic matter, such as sugar, amylaceous substances cellulose, &c. The bacteria are the agents of the transmission of oxygen even when it is engaged in a chemical combination. It is probably by reason of the consumption of oxygen which they effect that these animalcules are so dangerous to man. Nitrates are useful as manure, not merely by the nitrogen which they contain, but also by the oxygen, by the aid of which the bacteria destroy the

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cellulose. We have here doubtless the indication of a new point of view from which to study the putrefaction of vegetables.

Revue Universelle des Mines, de la Metallurgie, de Travaux Publics, des Sciences et des Arts Appliques a l'Industrie, July and August, 1875.

The only chemical matter in this issue consists of a paper on an arrangement for recovering the iodine sometimes present in phosphorites and liberated during its conversion into superphosphate, and of an account of the phosphate beds of Ciply, in Belgium. Both these papers are taken from the *Comptes Rendus*, and both have already been noticed in the CHEMICAL NEWS.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. No. 21 and 22, September and October, 1875.

These issues contain no chemical matter.

Les Mondes, Revue Hebdomadaire des Sciences, Nos. 3, 4, 5, and 6, Sept. 16, 23, 30, and Oct. 7, 1875.

These numbers contain no chemical or physical novelties.

M. Reimann's Farber Zeitung, No 39, 1875.

This issue contains receipts for a black on mixed wool and silk; for a yellowish and reddish Bismarck-brown on wool; a full blue-black for woollen piece-goods; and a paper on finishing woollens.

E. Kopp has discovered in Turkey-red goods, both before and after the clearing process, alumina and lime in the proportion of 1 atom of alumina to 2 of lime. In the cleared goods he detected also tin oxide in the proportion of 1 tin to 5 alumina and 10 lime.

In testing olive oils for Turkey-red dyeing, the same author recommends to pour into a glass 10 vols. of oil and 1 vol. of ordinary nitric acid, adding a few fragments of copper wire, and as soon as gas-bubbles in number penetrate the supernatant oil to mix with a glass rod, wait five minutes, stir again, let stand at 12° to 15°, and separate the oil from the acid, which will have taken a blue colour. After a time this congeals—the quicker the purer the oil. The product—elaidin—is hard and white. If the oil was mixed it congeals more slowly: the product is soft, yellow, or even brownish.

MISCELLANEOUS.

New Degree in State Medicine at Cambridge.—The first examination for this new degree has just been held in Cambridge. The degree is designed as a qualification for holding the post of Medical Officer of Health. Twenty candidates have passed. Among the Examiners we are pleased to observe the name of a well-known chemist, Mr. James Dewar.

NOTES AND QUERIES.

Society for the Promotion of Scientific Industry—Phosphoric Acid.—In reply to the queries of "An Old Subscriber," in the CHEMICAL NEWS, vol. xxxii., p. 194, the Society he refers to is in Manchester, and by addressing it he will obtain any information he may want. The yearly subscription is £2 2s.; the *Journal* is supplied to subscribers only. We cannot give the process for making phosphoric acid, but are prepared to supply it in quantity at 10s. per unit of P_2O_5 delivered, of a strength of 40 per cent P_2O_5. We will be pleased to receive any further queries and give any information on the subject in our power.—DUNN BROTHERS.

TO CORRESPONDENTS.

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Egremont.—Consult Morfit on "Soap." Published by Trübner and Co.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 831.

ON THE VARIATIONS IN THE COMPOSITION OF RIVER WATERS.*

By J. ALFRED WANKLYN.

I HAVE recently had an opportunity of making analyses of the water of the Nile, and have noticed a very interesting feature in that river.

The Nile is pre-eminently subject to flood, the rising of the Nile being, indeed, the chief event of the year in Egypt. Towards the end of May the Nile begins to rise, the increase in size being at first exceedingly gradual. In June the rise is just perceptible, and the river goes on increasing in volume until about the middle of September, in which month it usually attains its greatest size. Afterwards it sinks very gradually, and about Christmas it is low. From Christmas till towards the end of May the Nile remains pretty nearly stationary in size.

The cause of the rise of the river is said to be heavy rains in the months of April and May, the effect of this rainfall requiring the lapse of a considerable time in order to exert its full influence. Possibly, too, the melting of snow on mountains near the sources of the river may concur in flooding the river.

The height to which the Nile rises, as well as the exact period of the rise, varies from year to year, but it may be stated broadly that from the end of May until Christmas the Nile is more or less in flood, and from Christmas to the end of May the Nile is low. The following is a tabular statement of the composition of the water in different months:—

Water of the Nile.

Date of Sample.			Grains per Gallon.		
			Solids.	Chlorine.	Hardness.
1874	June	8..	15·0	1·80	7·0
	July	19..	13·0	0·50	6·0
	Aug.	12..	12·0	0·30	8·5
	Sept.	20..	10·0	0·40	8·0
	Oct.	12..	11·0	0·40	7·5
	Nov.	12..	12·0	0·50	8·0
	Dec.	12..	9·0	0·45	6·5
1875	April	.. .. ..	16·0	1·00	8·0
	May	13..	22·0	1·20	10·0

The remarkable point brought out in this table is the great relative alteration in the proportion of chlorine, that whereas in the beginning of June, just at the beginning of the rise of the Nile, the chlorine amounts to 1·8 grains per gallon; the chlorine sinks to 0·3 grain per gallon when the Nile has attained a great size, and remains at very little above that proportion until the end of the year.

As will be perceived, this diminution of the chlorine is proportionately very enormous, the ratio being 6·1. In order to be quite sure of the facts, I repeated the determination of the chlorine in the month of August, and took the precaution to evaporate down a quantity of the water to about a fifth of its volume before using the standard solution of silver. In this experiment I obtained 0·23 grain of chlorine per gallon of water. I also verified the figure 1·8 for June.

The extent of the fall in the chlorine is, therefore, quite as great as represented in the table. In marked contrast with the variableness of the chlorine, the table exhibits the comparative constancy of the hardness. On reflecting on the conditions under which the river is placed, the variableness of the chlorine and the constancy of the hardness become intelligible.

The water which swells the Nile in the latter half of the year is storm-water, being thick and muddy (as is well illustrated by the sample of Nile water exhibited in the Sanitary Exhibition). Storm-water sweeps over the surface of the country, without penetrating far below the surface, and we may very readily understand that such water, passing over a country long ago denuded of salt, should carry little or no salt into the Nile, which it dilutes, and so causes to contain only an exceedingly minute proportion of chlorine.

By about Christmas, the storm-water had ceased flowing into the Nile, which, during the spring half-year, must be fed with water which has passed deeper into the ground, and which has undergone concentration by evaporation, in addition to having washed extensive strata, from which, doubtless, it extracts chlorine. We can easily understand how the Nile should become more chlorinous as the spring advances, and how the chlorine should be at the maximum just at the beginning of flood-time.

The hardness, on the other hand, being due mainly to carbonate of lime, we can understand that, from the slightness of its solubility, the carbonate of lime, and consequently the hardness, should be under totally different conditions from the chlorine.

No doubt the *débris* carried mechanically down with the flood-water contains abundance of finely-divided carbonate of lime, so that the storm-water must always be saturated with carbonate of lime. When in flood, the Nile is, therefore, as hard as when it is not in flood, and the comparatively slight variation in hardness at different times will depend upon the varying amount of carbonic acid present in the river.

Although in the Nile the phenomena to which I have just directed attention are exhibited in a very marked manner, yet such phenomena are not confined to the Nile. If the investigation were made, I have no doubt that other rivers—the Danube, the Rhine, and even the Thames, for example—would be found to exhibit something of an analogous character, only in a far less degree; and when they are suddenly flooded these rivers should be less charged with chlorine than at other times. The importance of recognising the different causes to which fluctuation of chlorine in drinking-water is due will be obvious when it is considered how great a stress is laid upon the presence of chlorine as an index to sewage contamination.

Reverting to the Nile, I may append some determinations of the amount of organic matter in it at different times, premising, however, that my analyses were of necessity made on water which had been kept for a considerable period of time. The results are the following:—

Date when the Sample was taken from the Nile.	Parts per Million. Ammonia.	
	Free.	Albumenoid.
8th June, 1874	0·01	0·10
10th July, 1874	0·04	0·25
18th July, 1875	0·36	0·28

The water of the Nile is, therefore, sometimes quite as much charged with organic matter as the Thames at Hampton Court, where the London Water Companies draw the water. But, like Thames water, it is, no doubt, amenable to wholesale filtration, and a Nile water company ought to deliver excellent water.

As will be observed on turning to the tabular statement above given, the water of the Nile is only about half as hard as the London Thames water. I have also to add that it is not charged to any serious extent with either magnesia or sulphates.

* A Paper read at the Social Science Congress, Brighton.

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REPORT ON THE METHODS EMPLOYED IN THE ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS, AND ON THE MODE OF STATING THE RESULTS.*

(Concluded from page 202.)

Statement of Results of Analyses of Potash Salts.

The information the Committee has received on this subject is limited to the opinions of a few chemists. Without endorsing the whole of the following observations, the Committee believes that the subjoined remarks will be read with interest and advantage.

Messrs. Wallace and Co. write:—"It is quite likely that the sulphuric acid exists in these kelp muriates not as sulphate of potash, but as the double salt,—

$$3K_2SO_4 + Na_2SO_4,$$

discovered in kelp potash salts by Penny, of Glasgow; and if so, the large proportion of sulphates present in kelp muriates (usually from 4 to 6 per cent) would involve a slight alteration in the mode of stating the results, and would introduce sodium sulphate to a small extent. This view, however, even if proceeded upon in practice, would not interfere practically with the commercial value of the sulphates. There cannot be a doubt that the alkali present is carbonate of soda, both from the fact of these muriates *not being deliquescent*, and the impossibility of the existence of carbonate of potash and chloride of sodium together without mutual decomposition, otherwise carbonate of potash could be made by the simple process of mixing solutions of carbonate of soda and chloride of potassium."

Dr. Ulex, of Hamburg, writes:—"Potash, carbonate of potash, pearl-ash, generally contain sulphates (which require to be removed carefully by a chloride of barium solution before estimating the potassium). The whole of the potassium is estimated as chloride of platinum and potassium, and calculated to oxide of potassium. The sulphuric acid present is precipitated with chloride of barium as sulphate of baryta, the chlorine with a solution of silver as chloride of silver; the former calculated to sulphate of potash, the chlorine to chloride of potassium. The oxide of potassium equivalent to these two salts is subtracted from the total oxide of potassium, and the remainder calculated to carbonate of potash. Part of the sample is titrated with sulphuric acid, and noted as carbonate of potassium; subtract from this the carbonate of potash previously found, and calculate the difference to carbonate of soda."

Mr. Wm. Galbraith writes:—"'Muriates,' which may be alkaline and contain sodium carbonate (and therefore will not contain calcium and magnesium soluble in water), I should state thus, combining the stronger acids and bases first:—

Potassium	Sulphate.
Sodium	Chloride.
	Carbonate.

"When they contain calcium and magnesium soluble in water they should be stated thus:—

Calcium	Sulphate.
Potassium	Chloride.
Magnesium	
Sodium	

"In the case of 'artificial sulphates,' which contain iron, calcium, and magnesium, in addition to potassium and sodium, and are usually acid, the results may be stated thus:—

Hydrogen	Sulphate.
Calcium	Chloride.
Potassium	
Iron	
Magnesium	
Sodium	

"The free acid I state as sulphuric acid, as I cannot believe that it exists as hydrochloric acid, considering the heat of the furnace during the manufacture. Of course it is evident that the acidity will not be really due to '*free* sulphuric acid,' but to an acid sulphate, probably acid potassium sulphate, $KHSO_4$. Lumps of chloride are often to be found in salt-cakes and potassium sulphates of decided acid reaction. Of course carbonates should follow the same rules as the above."

Mr. M. J. Lansdell holds the following opinions:—"I think, in this as in all other instances, it is a mistake to give detailed analyses showing any particular arrangement of acids and bases combined. I advocate a simple statement of the elements (or acids and bases) separately, and any combining of them I am inclined to look upon as "padding" only (to use an expressive word), and as having weight only with the uninitiated. I do not object to a statement of any one (say a base) as being equal to a salt, not in the sense that that amount of that salt is present in that sample, but as a trade valuation of the base present according to a well-known or usual standard for its valuation. I find the practice of latter years, among our clients, is to ask only for certain determinations (in potash salts generally of potash only, or of potash and its equivalent amount of sulphate of potash or chloride of potassium), and not for detailed analyses, thus getting them done at a less fee. However, I should see no objection if the Committee thought fit to prescribe a mode of statement for detailed analyses which they found suited to the requirements of the trade, it being understood such analysis (quoted perhaps as the 'B. A. statement' or 'B. A. analysis') was only a statement in a conventional form. Yet a statement of the elements (or acids and bases) determined with at most their amounts in equivalent proportions (each equivalent proportion = 1 of hydrogen) would give to each manufacturer an easy means of making all calculations useful to him as to value, or the capabilities of the articles for separation or manufacture thereof of any compound, and would not parade a lot of fictitious or suppositious information to impose upon or awe the ignorant. I incline to the belief that every analyst should have respect to the ends sought, and need not go beyond them. A trader only finding some constituent or constituents of value for his purpose, should be accommodated with such on paying properly for them, and should not be led to require as 'the thing' a lot of other information, involving greater trouble and higher fees, to the limitation of general reference to the chemist. The sooner the public learns that chemists do not want to take advantage of them, but only to do what is of use to them, and that fees are not to be regulated by the number of items given (any more than an amount of money by the number of coins of various values it may be paid in, but also by the intrinsic value of each), the better I think it will be."

In the foregoing report the Committee has attempted to give an *epitome* of the very voluminous replies which have been received. It will be perceived that there are many points on which the evidence is very conflicting, and the Committee feels it impossible to recommend with confidence any particular process or processes, unless the special conditions of accuracy are very clearly defined. The large amount of information amassed during the past year has indicated very distinctly the directions in which further research is desirable, and the Committee therefore begs to be re-appointed, believing that before the next meeting of the Association it will be able to complete the proposed experiments and enquiries, and make a full report on the whole subject it was appointed to investigate.

* Presented to the British Association, Bristol meeting. Report of a Committee of Section B, consisting of E. C. C. Stanford, Chairman; James Dewar; Alfred E. Fletcher; and Alfred H. Allen, Hon. Secretary.

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The Committee has been re-appointed with a further grant of £20.

Communications should be addressed to the Hon. Secretary, Mr. A. H. Allen, 1, Surrey Street, Sheffield.

THE CONSTITUTION OF URIC ACID.

By S. E. PHILLIPS.

IT is well for a young athlete to ever have before him a task which, by better skill or strength, he may hope some day to surmount; in my case, however, other considerations are paramount. I have, indeed, projected a type of murexide constitution which might cover its genesis from tartronyl, nitro-phenyl, cresyl, or naphthyl bodies, but have hesitated to publish that which does not seem to well satisfy the end so much desiderated.

The amount of labour employed in the endeavour has been far more than I can promise in the future, with declining brain-power, and I must bequeath the difficulty to *good* friends, who may not be scientifically friendly.

As Strecker and Bayer have done so much in the matter, the hope is that, in spite of modern idiosyncrasies, they may go on to complete the history of alloxantin and the beautiful Tyrian dye, murexide.

Meanwhile, we offer the following section of that study having reference to the constitution of uric acid.

As the products of ordinary combustion are chiefly water and carbonic acid, so some of the products of human or animal combustion are notably urea, uric acid, and their analogues.

The heat- or life-giving process is, perhaps, a kind of nitrile reaction, by which ordinary materials are burnt or condensed to more ultimate products, as if the leading type of animal function were $-2HO$, while the converse assimilation in the vegetable kingdom involved a building up of the ordinary materials under the dominion of $+2HO$.

The thought is, that solar power is consumed in one phase and expended in the other.

That the urates, cyanurates, and others are not salts in any proper acceptation of that term, whether mono-, di-, or tri-basic, is a demonstration we must leave for the paper referred to, confining attention to the tabular genesis of uric acid and its analogues. (See below.)

In regard to the double lines of Nos. 1 and 2, the first thing to notice is the ready susceptibility of interchange between the upper and lower series—under hydride influences the two radicals, oxalyl and mesoxyl, readily pass into glyoxyl and tartronyl, and *vice versa*; and great has been the penetration to establish this much amid such complex materials, further darkened by imperfect types and confused nomenclature.

The folly of calling amides acids is well pourtrayed in this tabular series. Column 2 are all admittedly monureides. In the case of alloxan the nomenclature is exceptionally correct. We have alloxan and alloxanic acid—one the amide or urea, the other amide + 2HO, or the aminic acid; but oxalyl urea is called "parabanic acid," and the true acid form "oxaluric acid," and in a similar way malonyl urea is called "barbituric acid," &c. This also extends to column 3, where mycomelic acid, by another mode of genesis, is called "alloxanamide."

If the concretionary salts of lime and potash with uric acid be truly such, then it would follow that caffeine was a tribasic salt, and zinc amide would be a mono-, di-, or tribasic salt of zinc. All of which is equally absurd in sight of the fact that amides and ureas may have metal or other replacements of H. An urate of potash is similar

The Oxalyl Group gives Mycomelic Acid.

(1).	2 Oxalic acid	+ urea	− 4HO =	oxalyl urea	+ urea	− 4HO =	unknown amide.
				Parabanic acid.			
	$(C^2O^2)O+HO$	$(CO_2)H_4N_2$		$(CO)_2(C^2O^2)_2H_2N_2$			$(C^2O^2)_2Cy_2H_2N_2$
	Glyoxalic acid	+ urea	− 2HO =	glyoxalyl urea	+ urea	− 4HO =	*mycomelic acid.*
				Allanturic acid.			
	$(C_4H_1O_4)O+HO$			$(CO)_2(C_4H_1O_4)H_3N_2$			$(C_4H_1O_4)Cy_2H_3N_2$

The Mesoxyl Group gives Uric Acid.

(2).	2 Mesoxalic acid	+ urea	− 4HO =	mesoxyl urea	+ urea	− 4HO =	dehydric acid (?).
				Alloxan.			
	$(C^2O^2)O+HO$	„		$(CO)_2(C^2O^2)_2H_2N_2$	„	„	$(C^2O^2)_2Cy_2H_2N_2$
	Tartronic acid	+ urea	− 4HO =	tartronyl urea	+ urea	− 4HO =	*uric acid.*
				Dialuric acid.			
	$(C_6H_1O_6)O+3HO$	„	„	$(CO)_2(C_6H_1O_6)H_3N_2$	„	„	$(C_6H_1O_6)Cy_2H_3N_2$
(3).	Glycollic acid	+ urea	− 2HO =	glycolyl urea	+ urea	− 4HO =	glycoluril.
	$(C_4H_3O_4)O+HO$	„	„	$(CO)_2(C_4H_3O_4)H_3N_2$			$(C_4H_3O_4)Cy_2H_3N_2$
(4).	Malonic acid	+ urea	− 4HO =	malonyl urea	+ urea	− 4HO =	xanthine.
				Barbituric acid.			
	$(C_6H_1O_4)O+3HO$	„	„	$(CO)_2(C_6H_1O_4)H_3N_2$			$(C_6H_1O_4)Cy_2H_3N_2$
(5).	Pyruvic acid	+ urea	− 2HO =	pyruvic urea	+ urea	− 4HO =	(?)
	$(C_6H_3O_4)O+HO$	„	„	$(CO)_2(C_6H_3O_4)H_3N_2$			
(6).	Acetic acid	+ urea	− 2HO =	acetyl urea	+ urea	− 4HO =	(?)
	$(C_4H_3O_2)O+HO$	„	„	$(CO)_2(C_4H_3O_2)H_3N_2$			
(7).	(?) acid	+ urea	−	hydantoin	+ urea	− 4HO =	(?)
	$(C_4H_1O_2)O+HO$			$(CO)_2(C_4H_1O_2)H_3N_2$			

Ultimates inversely give Pseudo-Acid Bodies.

	Uric acid,	$C_6H_1O_6Cy_2H_3N_2$	$+2HO$ =	Pseudo-uric acid, $CO_2(C_6H_1O_6)CyH_5N_3$.
	Mycomelic acid,	$C_4H_1O_4,Cy_2H_3N_2$	$+2HO$ =	Allantoin, $CO_2(C_4H_1O_4)CyH_5N_3$.
	Glycoluril,	$(C_4H_3O_4)Cy_2H_3N_2$	$+2HO$	
	Xanthine,	$(C_6H_1O_4)Cy_2H_3N_2$	$+2HO$	
	Caffeine,	$(C_6H_1O_4)Cy_2Me_3N_2$	$+2HO$	
	Sarkine,	$(C_6H_1O_2)Cy_2H_3N_2$	$+2HO$	
$[H_2(NH_2)]$	Guanine,	$(C_6H_1O_2)Cy_2H_3N_2$	$+2HO$	
	(?)		$+2HO$ =	Pyruvil, $CO_2(C_6H_3O_4)CyH_5N_3$.

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to a parabanate of silver, and the mistake will be fully evident on a fair comparison :—

A parabanate of potash would contain the elements of .. } $CO_2(C^2O^2)_2HKN_2$.

An oxalurate of potash would contain the elements of .. } $CO_2(C^2O^2)_2H_3N_2O + KO$.

One is an amide with 1K replacing 1H ; the other is a true salt of potash.

It is important to appreciate the ideas conveyed by these types, and not less so to fully regard their temporary and *à priori* character. This may be seen in the effort to place guanine among these ultimates, where it is so intimately associated in the laboratory, otherwise we have given it a different notation, as associated with guanamine, $C_8H_7N_5$; guanine, $CO_2C_8H_5N_5$. These are curious, as associated with other simpler bases, where C=6 replaces H, atom for atom, in ammonia varieties.

It will be perceived that the so-called pseudo-acid amides are (column 2) +urea−2HO, instead of 4HO, and this leads to a consideration of the generic character of that reaction.

Applied to column 1, it is one of the simplest and widest character, but, although so well known, yet its true function is easier to notate than to describe in words :—

Hydrate	+ ammonia	− 2HO =	an amide.
$(C_4H_5)O+HO$	HH_2N	=	$(C_4H_5)H_2N$.

The 2HO eliminated.

Applied to column 2, the notably curious thing to observe is, that the same tendency to elimination of 2HO still continues, and whether it be 2 or 4 HO will depend on the intensity of the conditions employed. What, then, is the character of the reaction ?

Experience teaches that two alternatives subsist. Either the radical will be degraded or nitrilised by loss of −HO, or a cyano re-arrangement will result. The first is well exemplified in the glucoside condensations of M. Schiff (see CHEMICAL NEWS, vol. xxviii., p. 116), thus :—

Esculetine + aniline −2HO = $(C_{18}H_5O_6)PhHN$

$(C_{18}H_5O_6)O + HO + 2PhH_2N - 4HO = (C_{18}H_3O_4)Ph_2H_3N_2$

" $+3PhH_2N - 6HO = (C_{18}H_1O_2)Ph_3H_5N_3$

The second may be expected in all ureide combinations, where the characteristic $(CO)_2$ of urea changes, by loss of 2HO, to the production of cyanogen ; and that this is the predominant feature of the case there can be but little doubt.

I do not wish to convey the idea that in all cases this tendency has been literally and exactly fulfilled, as represented in the tabular series, but simply that a good ground is submitted for such *à priori* projections. In principle, the reaction is well known :—

Urea	− 2HO =	cyanamid.
$CO_2H_4N_2$		CyH_2N

Glycolyl urea + H_3N	− 2HO =	glycocyamine.
$(CO_2)(C_4H_3O_4)H_3N_2$		$Cy(C_4H_3O_4)H_4N_2$

And that this really is a cyano transposition may be seen in the direct synthesis of the latter and other similar compounds ; thus, cyanamid and glycocoll unite to form glycocyamine—

$$\left.\begin{matrix} CyH_2N \\ C_4H_3O_4H_2N \end{matrix}\right\} = Cy(C_4H_3O_4)H_4N_2.$$

It seems very strange, if it has not occurred to M. Baeyer and his distinguished colleagues, to aim at the synthesis of the uric acid ultimates in this simple and direct manner. Representing the tartronyl or other radical as R, we then might have—

$$\left.\begin{matrix} CyH_2N \\ RCyHN \end{matrix}\right\} = Cy_2RH_3N_2,$$

the assumed type of uric acid.

In a study of the −2HO of the rosaniline condensations we have separately estimated both these tendencies, the balance of probability, perhaps, leaning towards the nitrile reduction ; but the difficulties of di- and tri-atomic hypotheses, as applied to those reduced hydrocarbon radicals, have retarded research in that direction.

In the case of the ureide ultimates, it is not at all easy to admit the same alternative, and taking the materials of tartronyl urea+urea−aq., and trying to shut our eyes to the force and simplicity of the above reactions, we should then have—

For the pseudo acid .. .. } $-2HO = (CO)_4(C_6H_1O_4)H_5N_4 = H_{10}N_4$.

For the uric acid $-4HO = (CO)_4(C_6H_1O_2)H_3N_4 = H_8N_4$.

It is true that such abortions of numerical proportion can be found in the types of M. Baeyer and others, but the presumption is strong that they have no place in the endless natural varieties of ammoniacal type.

It only remains to notice the vague uncertainties in connection with Nos. 3 and 7.

M. Baeyer essays to prove "that hydantoin is really glycolyl urea."

Bromacetyl urea + $H_2O + H_3N - H_4NBr$ =

$= CH^2(C^1H^1O)N^1O$.

That this is an imperfect and roundabout way of getting "glycolyl urea" may be admitted, but that the product is, at the same time, "hydantoin," is quite another matter.

In a study of the benzo-creatinine research of M. Griess, we have regarded hydantoin as—

$(C_4H_3O_4)CyHN$ (*a*),

and in the present tabular series as—

$CO_2(C_4H_1O_2)H_3N_2$ (*b*).

We do not define which is the "hydantoin" of the books, but we do affirm the legitimacy of both types, as isomeric forms produced under different conditions.

That (*a*) + cyanamid would give glycoluril is highly probable :—

$$\left.\begin{matrix} CyH_2N \\ Cy(C_4H_3O_4)HN \end{matrix}\right\} = Cy_2(C_4H_3O_4)H_3N_2.$$

I would submit to Mr. J. Reoch, who is chivalrously working at this difficult problem, in the best of all ways, that his litmus test of an acid, as contradistinguished from an amide, is invalid.

Some characteristic amides may be indifferent to that test, but many ureides are not the less truly amides, because while in solution they may take up 2HO and behave as acids.

He might also examine the allegation that—

Dialuric acid + ammonia − 2HO = dialuramide,

which, interpreted by the language and ideas of this paper, would mean—

Tartronyl urea	+ H_3N − 2HO =	uramil.
$(CO_2)(C_6H_1O_6)H_3N_2$		$(C_6H_1O_6)CyH_4N_2$

But how it is that two atoms of that amide break up, by oxidation, to the production of murexide, is the problem of problems which yet remains a reproach to chemistry.

ON THE MANUFACTURE OF WHITE CAUSTIC SODA.*

By GEORGE E. DAVIS, F.C.S.

(Concluded from p. 200).

Section 5.—Finishing.

We have now in our settlers or in our pots liquor which has boiled to 280° F. and settled. This liquor is baled or run into other pots, and kept boiling until a temperature of 320° F. has been arrived at. From 290° F. to this temperature a scum forms upon the top of the pot which sometimes appears red or even black ; this is often re-

* From the *Journal of the Society for the Promotion of Scientific Industry.*

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moved by means of perforated scoops, even for the production of 60 per cent caustic, while in some works it is not removed.

It is, however, imperative to remove it in making 70 per cent caustic, and whether nitre has been added or not, the scum appears to have the same composition, as the following analyses will show :—

	A.	B.
Iron peroxide	traces	traces
,, sulphide	0·139	0·346
Sodium sulphite	51·408	57·120
,, hyposulphite	none	traces
,, sulphate	6·831	5·377
,, chloride	5·265	6·172
,, silicate	0·225	traces
,, aluminate	traces	traces
,, carbonate	15·408	13·013
,, hydrate	20·800	17·672
	100·076	99·700

A was from liquor boiled to 320° F., the liquors oxidised during causticisation, but no nitre added to pans.

B was from liquor boiling at the same temperature, but nitre added in the boat pans, and it may be worthy of remark that both samples were pressed and dried before analysis.

These salts are in some works put straight into the black-ash mixing; in others they are first washed with weak liquor; a different plan is followed by some, who put them into the strong pans, where the sulphite, sulphate, and carbonate fall with the other salts, the chloride and caustic being dissolved. No other precaution being necessary for 60 per cent caustic, I will now turn my attention to the preparation of 70 per cent.

The liquors after boiling to 280° F. contain too many salts to always give 70 per cent with ease and certainty, so when this strength is required the best plan is to boil until the contents of the pot reach 320° F., and again allow it to settle. Chloride, carbonate, and sulphite now settle out, as may be seen in the following analysis :—

Iron peroxide	1·054
Sodium sulphite	3·603
,, hyposulphite	0·442
,, sulphate	1·146
,, chloride	41·535
,, silicate	0·174
,, aluminate	0·544
,, carbonate	11·488
,, hydrate	19·840
Water (by diff.)	20·174
	100·000

When making 70 per cent caustic by the plan of separating the salts in one operation, the liquor from the black-ash boat pans is boiled directly to 320° F., and allowed to settle from twelve to twenty-four hours, after which the supernatant liquor is baled off for finishing.

The boiling of the liquor is then continued, and when the temperature of the liquor has reached 355° F. it will solidify well on cooling and will contain about 53 per cent of alkali. The temperature of the pot then rapidly rises until at about 400° F., when very little steam seems to be evolved, though the contents of the pot still contain nearly 20 per cent of water; at 460° F., a few degrees above or below, the caustic will contain as nearly as possible 60 per cent of alkali, at 470° F. it will contain about 61 per cent, and at 500° F. it will contain about 64 per cent.

About this time there is very little motion to the contents of the pot, and in a short time the heat has risen above the range of a mercurial thermometer. There is at this stage an evolution of some pungent matter due to the action of the caustic soda upon organic matters present in the solution, and which probably is of several kinds, and with this the surface of the pot becomes covered with graphite. The cover is then placed on the pot and the fire urged until the workman declares it "up to heat;" the oxidation of the sulphides may then commence, and may be effected by two different methods; first, by the injection of air, and secondly, by the means of nitre.

In the first case air is blown into the caustic, which is now in the state of igneous fusion, until the sulphide of sodium is nearly oxidised to sulphate; a trace of sulphide is always left in at this stage, for if completely oxidised here, the action of the air would be sufficient to give a shade of green to the finished caustic, owing to the formation of a little sodium manganate. Many samples of commercial caustic soda will contain traces of sulphide, but there should be none in the best qualities.

Some manufacturers use a small excess of nitre, and destroy the green colour afterwards by the addition of sulphur or sodium hyposulphite, which latter is generally known in a caustic works as "crystal." In the case of oxidising with sodium nitrate, this salt is added cautiously in order to avoid excess, a trace of sulphide being also left in as in the last method.

Whether the sulphide in this stage of its oxidation passes through the states of hyposulphite and sulphite into sulphate is difficult to say. Probably not, for a hyposulphite could not exist at this temperature, though there is just the possibility of its being split up at the instant of its formation into sulphate and sulphide. Sulphate is the ultimate product, associated, however, with minute quantities of either sulphite or sulphide.

If the oxidation takes place as indicated by Pauli, the water must be eliminated from his equation, for the caustic is in the state of igneous fusion, and contains no water in excess of that necessary to form the hydrate of soda; the reaction then would probably be—

$$5Na_2S+8NaNO_3=5Na_2SO_4+4Na_2O+8N.$$

After the oxidation has been nearly completed, a sample is withdrawn (preferably in a mould such as is used by pharmacists for casting the sticks of caustic potash in) and examined for its amount of total alkali. In this state it is a stick of coloured caustic, the intensity of the colour depending upon the mode of working, and appearing from a light brown to a deep red. If 60 per cent is being prepared the samples may be of the following composition :—

	A.	B.
Sodium hydrate	82·193	83·566
,, carbonate	2·404	3·174
,, chloride	6·000	8·664
,, sulphate	7·337	3·629
,, silicate	0·284	0·223
,, aluminate	1·216	0·231
,, sulphide	0·018	0·035
Insoluble	0·492	0·386
	99·944	99·898

A is a sample of the contents of a pot at this stage from a works where the solution of the bottoms was introduced into the operation pan.

B is from the same works when the bottoms were packed and sold, consequently not re-introduced into the process.

From the strength of the caustic as found by experiment the quantity of salt necessary to reduce it to 60 per cent is calculated, which is added, and the pot is again brought "up to heat," after which the fires may be allowed to burn out, and the pot settled. After allowing to stand for a time, which may vary from six to eighteen hours as the two extremes, but which is naturally about eight hours; the settling takes place as mentioned in Ralston's patent; "the oxide of iron is precipitated to the bottom of the vessel," and besides this the alumina separates itself completely from the sodium hydrate and falls to the bottom of the pot with the iron oxide as aluminate of soda, which is completely soluble in water.

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It is upon this settling process that the excellence of the caustic depends, and in some works where there is plenty of pot room, it is customary to allow the pots to settle until a thick crust has formed upon the surface before it is allow to be packed.

Some pots absolutely refuse to settle well, and this generally happens when there is only a minimum amount of iron oxide in suspension with a considerable quantity of aluminate of soda, which, of itself, is so dense that it falls through the hydrate to the bottom of the pot, and the small quantity of iron oxide seems to be retarded in its settling by this dense liquid.

This bad settling often happens when liquors are dealt with which have been completely oxidised during causticisation. The sodium sulphide has been oxidised to hyposulphite, which does not dissolve the iron of the concentrating pans; the pans are saved, but at the expense of bad settling caustic. If, however, the liquors have not been oxidised, the sodium sulphide will dissolve the pans with the production of the sodium iron sulphide, but the caustic obtained from these liquors will settle with ease and rapidity.

In my opinion this difficulty may be sometimes overcome by the introduction of some of the iron oxide; the deposit from the solution of bottoms when the temperature of the contents of the pot is about 400° F. It is a well known laboratory fact, that traces of precipitates often refuse to settle, and remain suspended in liquids for long periods; but when the same precipitates are present in large quantities, the precipitation is easily and rapidly effected. Apply this reasoning to the case of bad settling caustic, and there is no doubt that the modification I have mentioned will give good results.

Sometimes, although clear when well fired, the pot will assume a milky tinge when cooling, and after cooling in the drums a portion will be found slightly discoloured; but on solution in water a minute quantity of a white precipitate is obtained, which precipitate sometimes becomes slightly brown by exposure to the air, and consists chiefly of alumina and lime coloured with minute traces of iron or manganese.

This precipitate is probably a calcium aluminate, and inquiries on its formation have generally led to the fact that through some negligence on the part of the workmen lime has been introduced into the process, either through the medium of non-settled causticised liquor, or, what I have several times found, that dried vat waste had been employed by the finisher to correct his over-nitred pots, or had been introduced by another workman out of spite towards the finisher.

When the caustic has settled sufficiently it is baled into thin sheet iron drums for sale, the doubtful part near the bottoms being either baled into the next strong pot, or sometimes sold as discoloured caustic, while the bottoms are plunged up, and, when sold, they are packed in drums, but when dissolved they are ladled into iron bogies to solidify, and when set are broken up.

Where a large amount of very light coloured bottoms are obtained from a pot they are sometimes baled into the next pot, and often something may be gained by this mode of working; but where the percentage of bottoms seems on the increase, every care should be taken to eliminate the alumina from the process, or at any rate reduce its amount to the minimum.

Good white caustic soda is also made from red liquors, both from Gossage's process, and also from the over heat black-ash pans. The *modus operandi* is nearly the same as has been just described; the only difference consists in separating a larger quantity of salts, for the proportion of "salts" to caustic soda is much greater than when vat liquors are used. It is usual to boil to a higher temperature before settling, to settle longer before finishing, and to well crust the pots before packing.

The red liquors from the black-ash pans are generally of a gravity of 62° Tw. The following is an analysis of them:—

Sp. gr. 61½° Tw. at 56° F.

Iron sulphide	0·313
Sodium bisulphide	0·195
,, sulphide	6·256
,, sulphite	16·022
,, hyposulphite	7·858
,, sulphate	14·848
,, chloride	65·526
,, silicate	9·677
,, aluminate	1·031
,, carbonate	79·966
,, hydrate	194·400
,, sulphocyanide	0·261
,, ferrocyanide	0·423
Grammes per litre	396·756

I now proceed to give some full analyses of the finished caustic, starting with white 60 per cent.

	A.	B.
Sodium hydrate	72·774	75·246
,, carbonate	1·419	2·536
,, chloride	18·800	17·400
,, sulphate	6·462	4·398
,, sulphite	0·063	0·027
,, silicate	0·304	0·297
,, aluminate	trace	trace
	99·822	99·904

It will be seen by the above analyses that the insoluble matter as well as the sodium aluminate has been separated by subsidence; this occurs likewise in 70 per cent, as may be seen in the following analyses:—

White 70 per cent.

	A.	B.
Sodium hydrate	83·840	89·600
,, carbonate	4·686	2·481
,, chloride	6·522	3·919
,, sulphate	4·526	3·419
,, sulphite	0·025	0·025
,, silicate	0·463	0·304
,, aluminate	trace	trace
	100·062	99·748

Now follow some bottoms from 60 per cent caustic soda.

	A.	B.	C.
Insoluble matter	23·000	1·948	4·664
Sodium hydrate	58·888	70·896	71·866
,, carbonate	trace	none	0·722
,, chloride	6·135	14·040	10·729
,, sulphide	0·132	0·054	0·116
,, sulphite	0·151	0·063	0·074
,, sulphate	5·534	3·526	4·624
,, silicate	0·683	trace	trace
,, aluminate	5·661	9·556	7·133
	100·184	100·083	99·928

These analyses show where the alumina and oxide of iron has gone.

A was from a pot very red before salting.

B was from a pot, the liquors being thoroughly oxidised during causticising.

C from liquors only partially oxidised during causticising.

The following analyses will serve to show the nature of the insoluble matter:—

	A.	B.
Graphite	2·146	1·179
Iron peroxide	93·000	94·006
Calcium oxide	4·332	4·289
Manganese oxide } Magnesia, &c. }	0·522	0·526
	100·000	100·000

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A was the insoluble portion of the bottoms A, and B the insoluble portion from the C bottoms in the same series.

Before concluding, I think I should state what is published concerning white caustic soda, as if I did not I might be taxed with not acquainting myself with the bibliography of my subject. From what I can learn nothing has been written save the single paper of Dr. Pauli in June, 1862. We have wonderfully improved in the manufacture since 1862, and as we have had no record of what has been done and what is going on now, therefore I hope this paper may be deemed worthy of a place amongst technological records.

SIR CHARLES WHEATSTONE.

Many of our most eminent scientific men pass away after a life of useful scientific labour without attracting much attention from the outside world. Their death is mourned only by those who were devoted to them by ties of relationship or personal friendship, and only when we lose a Faraday or a Wheatstone does the public mind realise the great loss science has sustained. Identified as he was with the practical development of telegraphy, the name of Wheatstone was familiar to all, and the fact of the later years of his life having been devoted to subjects connected with electricity has led even the scientific world to lose sight of his valuable work in other branches of physics. As early as 1823, while engaged in the manufacture of musical instruments, Charles Wheatstone published a paper on "New Experiments on Sound," and on looking through the list of his published papers one recalls the value of his experiments in connection with sound and light. Still it is as the electrician that Wheatstone rose to the first rank in science, and, as we have already said, it is the conspicuous part he played in the invention and application of the electric telegraph that raised him so high in popular esteem. In 1834 Professor Wheatstone was appointed Professor of Experimental Philosophy at King's College. In 1836 he was elected a Fellow of the Royal Society, when he read a paper entitled "Contributions to the Physiology of Vision," and this led to the invention of the stereoscope, which he first exhibited at the meeting of the British Association for the Advancement of Science in 1838.

In 1868 Wheatstone was knighted in recognition of his scientific services, but thirteen years before the Emperor of the French had appointed him a Chevalier of the Legion of Honour on account of his application of the Electric Telegraph. He was also a Member of the French Academy. At the sitting of the Academy last Monday week M. Dumas announced that Sir Charles Wheatstone was lying ill at the Hotel du Louvre. On the 20th inst. the sad news of his death was telegraphed to London. Previous to the removal of the body from Paris to London a funeral service was held at the English Church in the Rue d' Aguesseau, when Lord Lyons and a deputation from the Academy of Sciences were present. MM. Dumas and Tresca referred in feeling terms to the loss which science had sustained; they also referred to his scientific labours, and to the important discoveries with the electric telegraph which would immortalise his name.

The funeral took place at Kensal Green Cemetery on Wednesday last. Many eminent friends and co-labourers were present at the grave. The coffin plate bore the simple inscription—

Sir Charles Wheatstone,
Died October 19, 1875.
Aged 73 Years.

The following list of papers by Sir Charles Wheatstone is abridged from the Royal Society catalogue:—

1. New Experiments on Sound. *Thomson, Annals of Phil.*, 1823.
2. Experiments on Audition. *Quart. Journ. Sci.*, 1827.
3. Description of Kaleidophone. ,, ,, 1827.
4. Resonances of Columns of Air. ,, ,, 1828.
5. Transmission of Sounds through Solid Linear Conductors, and Subsequent Reciprocation. *Journal Roy. Inst.*, 1831.
6. On Purkinje's Figures. *Brit. Ass. Rep.*, 1831.
7. Bernoulli's Wind Instrument (Theory). *Brit. Ass. Rep.*, 1831.
8. On Chladni's Figures. *Phil. Trans.*, 1833.
9. Velocity of Electricity and Duration of Electric Light. *Phil. Trans.*, 1834.
10. Prismatic Decomposition of Electric Light. *Brit. Ass. Rep.*, 1835.
11. Imitation of Human Speech by Mechanism. *Brit. Ass. Rep.*, 1835.
12. Thermo-Electric Spark. *Phil. Mag.*, 1837.
13. Physiology of Vision. *Phil. Trans.*, 1838.
14. Binocular Vision. *Brit. Ass. Rep.*, 1838.
15. Electro-Magnetic Clock. *Proc. Roy. Soc.*, 1840.
16. Electro-Magnetic Telegraph. *Sturgeon, Ann. Elect.*, 1840.
17. Letter to Col. Sabine on Meteorological Instruments. *Brit. Ass. Rep.*, 1842.
18. Constants of Voltaic Current. *Phil. Trans.*, 1843.
19. Meteorological Registers (Electro-Magnetic). *Achives l'Elect.*, 1844.
20. Juxtaposition of Several Colours. *Brit. Ass. Rep.*, 1844.
21. Electro-Magnetic Chronoscope. *Comptes Rendus*, 1845.
22. Determination of Solar Time by Polarisation. *Brit. Ass. Rep.*, 1848.
23. Foucault's Rotation of Earth. *Proc. Roy. Soc.*, 1851.
24. Physiology of Vision. *Phil. Trans.*, 1852.
25. Binocular Microscopes. *Trans. Mic. Soc.*, 1853.
26. Fessil's Gyroscope. *Proc. Roy. Soc.*, 1854.
27. Powers for Arithmetical Progression. *Proc. Roy. Soc.*, 1854 and 1855.
28. Submarine Cable of Mediterranean. *Proc. Roy. Soc.*, 1854 and 1855.
29. Aluminium in Voltaic Series. *Proc. Roy. Soc.*, 1854 and 1855.
30. Automatic Telegraphy. *Comptes Rendus*, 1859.
31. Prof. Charles Wheatstone and T. R. Robinson, Report of Committee on Captive Balloons. *Brit. Ass. Rep.*, 1843.

SOCIETY OF PUBLIC ANALYSTS.

The following circular has been issued by the Local Government Board, and, as expressing the views of that department on the "Sale of Food and Drugs Act," should be read with care by all Public Analysts:—

County Authorities.

The Sale of Food and Drugs Act, 1875.

Local Government Board, Whitehall, S.W., 30th September, 1875.

Sir,—I am directed by the Local Government Board to draw the attention of the Town Council to the Sale of Food and Drugs Act of the last Session (38 and 39 Vic., c. 63), which will come into force on the 1st of October, 1875.

In accordance with the recommendation of the Select Committee of the House of Commons upon the Adulteration of Food and Drugs Act, 1872 (35 and 36 Vic., c. 74), the present statute repeals that Act, together with the Adulteration of Food and Drink Act, 1860 (23 and 24 Vic., c. 84), and the 24th section of the Sale of Poisons and Pharmacy Act, 1868 (31 and 32 Vic., c. 121), and, whilst re-enacting several of the provisions thus repealed, it has made many important amendments in the previous law.

The following statement shows the most material of these amendments:—

Appointment of Analysts.

Express power is now given to the Local Government Board, by section 10, to require, in the case of any future appointment of an Analyst, satisfactory proof of his competency. They are, moreover, empowered to qualify their approval by such modifications with respect to the period of appointment and removal, or otherwise, as they may think proper. It must, however, be distinctly understood that these provisions do not in any way relieve the Local Authority from the responsibility of satisfying themselves that the person appointed by them is in every respect qualified to discharge with efficience the duties of his office.

Another important amendment is, that in future no Analyst is to be appointed for any place in which he is engaged, either directly or indirectly, in any trade or business connected with the sale of food or drugs.

The Act of 1872 prescribed as the qualifications of an Analyst that he should possess competent medical, chemical, and microscopical knowledge; but section 10 of the new Act requires that he should possess competent knowledge, skill, and *experience*.

The Act, however, in no way interferes with any existing appointment.

In consequence of the difficulty which has been experienced in obtaining the services of a competent Analyst for small areas, section 11 empowers the Town Council of any borough to engage the services of the Analyst for the county or any neighbouring borough, and the Board hope that the Local Authorities referred to will freely avail themselves of this new power. At the same time, they remark that the facilities thus afforded by the Legislature to meet the difficulty referred to has removed any ground that may have previously existed for neglecting to comply with the requirements of the law.

Duties of Analysts.

Complaints have been made that, when a long interval has been suffered to elapse between the taking of the sample and the making of the analysis, in the case of commodities liable to decomposition, a change has often taken place in the constitution of the article, which has rendered the analysis unreliable. These complaints are met by section 13, which requires that the analysis shall be made with all convenient speed; and it will be seen, by reference to the note to the form of certificate given in the schedule, that, as regards perishable articles, the Analyst is to report specially whether or not any such change has taken place.

Under the repealed Acts, the Analyst was required to specify in the certificate whether, in his opinion, the article was adulterated, and in the case of articles of food and drink, whether they were so adulterated as to be injurious to the health of the consumer. In the present Act a form of certificate is prescribed, which requires him to state the parts or percentages of the foreign materials; but he will be at liberty to express therein his opinion as to the purpose for which the mixture was made, and also whether or not the ingredients are injurious to health.

The Act of 1872 required the Analyst to make to the Authority by whom he was appointed a quarterly report, showing the number of articles analysed and the nature of the adulterations detected. Every such report must, for the future, specify the result of each analysis and the sum paid in respect thereof, and must be presented at the next meeting of the Authority. Certified copies of all such reports are to be annually transmitted by the Authority to the Local Government Board. (See section 19.)

Proceedings to obtain Analysis.

Under the Act of 1872 the only officers who could be employed to obtain samples for analysis were inspectors of nuisances, inspectors of weights and measures, and inspectors of markets. Section 13 authorises the employment of medical officers of health and police constables for this purpose, in addition to the inspectors before referred to, and not only the Authority appointing such officers, but any Authority charged with the execution of the Act may direct them to procure samples.

Another important amendment will be observed in section 14, which requires the purchaser to notify to the seller, after the purchase has been completed, his intention to submit the article purchased for analysis, and to offer to divide it into three parts, each to be marked and sealed or fastened up. If such offer is accepted, he is to deliver one of such parts to the seller and one to the Analyst, and to retain the third himself, for production in case of proceedings. If the offer is refused, the purchaser is to divide the article into two parts, retaining one himself, and delivering or sending the other to the Analyst.

Hitherto it has been necessary for the officer of the Local Authority personally to deliver the samples to the Analyst. This provision having entailed considerable expense and inconvenience, especially in cases where the Analyst resided outside the district, it is provided by section 16 that if he does not reside within a distance of two miles of the residence of the person requiring the article to be analysed, the sample may be forwarded to him by post in a registered packet, subject to any regulations of the Postmaster-General.

It has frequently happened that a trader has refused to allow a sample to be purchashed when he has had a suspicion that it was required for analysis. Section 17 now imposes a penalty not exceeding £10 upon any trader refusing to sell, for analysis, samples in such quantity as shall be reasonably requisite of any articles exposed for sale, if the officer tenders the price for the same.

Description of Offences.

In lieu of the somewhat complicated provisions of the previous Act as to the offences of adulterating articles with injurious ingredients, and of selling the same when so adulterated, the present Act (sec. 3) imposes a penalty of £50 for mixing, with intent to sell, any article of food with any ingredient so as to render the article injurious to health, or for selling any article so mixed, the offender being liable to be imprisoned for six months, with hard labour, for every second and subsequent offence.

Section 4 imposes similar penalties on any person who, except for the purpose of compounding in accordance with the demand of the purchaser, mixes, with intent to sell, any drug with any ingredient so as to affect injuriously its quality or potency, or who sells any drugs so mixed.

By a further amendment (section 5) proof of guilty knowledge on the part of the defendant is not required from the prosecutor; but the defendant may show that he had no knowledge of the adulteration, and that he could not, with reasonable diligence, have obtained that knowledge.

The principal offence created by the Act of 1872 was that in relation to the ordinary retail sale of articles of food which had been adulterated, although not with injurious or poisonous ingredients; but, as there was no statutory definition of the term adulteration, there was a great want of uniformity in the administration of the law, and considerable hardships were in consequence inflicted upon some branches of the trading community.

It is obvious, moreover, that there may be other fraudulent practices which do not necessarily constitute adulteration, such as the substitution of one article for another, or the admixture of one article with another of the same kind, but of inferior quality. The term adulteration, therefore, is not used in the present Act: and in future it will constitute an offence to sell, to the prejudice of the purchaser, any article not of the nature, substance, and quality of that demanded. It will not, however, be an offence to add to food or drugs any matter or ingredient required for their production or preparation of articles of commerce in a state fit for carriage or consumption, provided that the addition does not fraudulently increase the bulk, weight, or measure of the article, or conceal its in-

ferior quality. Exceptions are also made in favour of proprietary medicines and patented articles; and the seller is also protected when the article is unavoidably mixed with extraneous matter in the process of collection or preparation.

Section 8 further amends the law, in the case of compound articles, by enabling the seller to protect himself against proceedings if, with the article, he delivers to the purchaser a label, distinctly and legibly written or printed, to the effect that the article is mixed. It is necessary, however, that the matter added should not be injurious to health, or intended fraudulently to increase the bulk, weight, or measure, or to conceal the inferior quality of the compounded article. The giving of a false label renders the person liable to a penalty of £20.

While these alterations have been made to meet the reasonable objections of traders as to the uncertainty of the law, it will be seen that section 9 constitutes a new offence, by providing that no person shall, with the intent that the same may be sold in its altered state without notice, abstract from any article of food any part of it, so as to affect injuriously its quality, substance, or nature; and no person shall sell any article so altered without making disclosure of the alteration, under a penalty not exceeding £20. This amendment will, for example, render the fraudulent abstraction of cream from milk an offence punishable summarily.

It will be observed that, with respect to tea, special provision is made by section 30, under which all imported tea will be subject to examination by persons appointed by the Commissioners of Customs; but, although this provision will doubtless operate as a protection both to the public and the trading community, it will not exempt any seller of tea from the proceedings to which he may be liable under the provisions before mentioned.

Before concluding this part of their circular, the Board are desirous of removing an erroneous impression which appears to prevail in certain localities, viz., that the special legal provisions made by the Licensing Act, 1872, with regard to the offence of adulterating beer, are still in force.

It is true that statute carried enactments an the subject, and a schedule of adulterants of beer was appended to it. Moreover, certain regulations, framed with regard to the then state of the law, were issued, under which the officers of the Commissioners of Inland Revenue and the police were in the habit of instituting prosecutions in cases where the percentage of salt and other substances was considered excessive. The Act of 1872, however, together with the schedule, was repealed by the Licensing Act, 1874, with the express intention that proceedings for the offence of adulterating beer should thenceforward be placed on the same footing as those in respect of other articles.

Proceedings against Offenders.

An important amendment in the law will be found in section 21, which enables a defendant to tender himself and his wife to be examined on his behalf.

It will also be observed that the Justices of Court of Appeal may in their discretion, upon the request of either party, cause any article to be sent to the Commissioners of Inland Revenue to be analysed by the chemical officers of that department at Somerset House, the expense of such analysis to be paid by the complainant or defendant, as the Justices may direct. It will also be competent for the defendant to require the Analyst to be called as a witness, and the parts of the articles retained by the purchaser to be produced (section 21).

As it is important that great care should be observed in forwarding the samples to the Commissioners of Inland Revenue, and that the analysis should be effected with the greatest despatch consistent with accuracy, the Commissioners have prepared instructions for the guidance of the Clerks to the Justices in performing the new duty imposed upon them. A copy of these instructions is appended to this circular, and the Board suggest that the Court of Quarter Sessions should cause them to be communicated to the Clerks to the Justices in the several Petty Sessional Divisions of the County.

In connection with proceedings against offenders, the Board may further point out that it will be open to the defendant to prove that he is protected by any provision or exception contained in the Act with reference to compounded articles. He will be entitled to be discharged if he proves, to the satisfaction of the Justices or Court, that he bought the article as the same in nature, substance, and quality as that demanded of him, and with a written warranty, that he had no reason to believe that the article was otherwise, and that he sold it in the same state as when he purchased it; but he will be liable to pay the costs of the prosecutor in such a case, unless he has given him due notice of his intention to rely on this defence.

Section 27 constitutes the forging of a warranty a misdemeanour punishable by imprisonment, and imposes a penalty of £20 for the misapplication of warranties and the giving of false warranties.

Section 28 enables a person in an action brought by him for breach of contract on the sale of any article of food or of any drug, to recover the penalty incurred by him, together with the costs in relation to the proceedings under the Act, if the article was sold to him as being of the same nature, substance, and quality as that which was demanded of him, and he purchased it not knowing it to be otherwise.

Application of Penalties.

Penalties recovered under the Act by the officers of a Local Authority who have appointed an Analyst, or agree to the acting of an Analyst within their districts, are to be paid to them, and by them to such Authority, to be applied towards the expenses of executing the Act.

The Board have thought it right not to confine their observations to those provisions of the Act which relate more immediately to the duties devolving upon the Court of Quarter Sessions; but in drawing attention to a statute of so much importance, they have adverted to the chief alterations in the law which affect the trading community and the public, and which may be summed up as follows:—

As regards the Trading Community.

It protects the seller—

(1). By permitting those practices in the established usage of trade with respect to the addition of harmless ingredients not intended fraudulently to increase the bulk or weight of the article, or to conceal its inferior quality, which clearly ought not to constitute an offence.

(2). By enabling him to protect himself in the case of a mixed article, by affixing a label to it.

(3). By giving him the right, when he has a written warranty, to plead the warranty as a defence.

(4). By providing that, if convicted, he may, in an action against the wholesale vendor for breach of contract, recover the costs of his conviction, if he proves that the article was sold to him as being of the same nature, substance, and quality as that demanded of him, that he purchased it not knowing it to be otherwise, and that he afterwards sold it in the same state.

(5). By requiring the purchaser, when he intends to have the article analysed, to divide the sample, and leave one part with the seller.

(6). By providing, in the case of tea, that it shall be examined by officers of the Customs at the port of landing.

(7). By enabling the seller and his wife to be examined as witnesses on his behalf.

(8). By authorising the Justices, where the result of the analysis is questioned, to have the article referred for analysis to the laboratory at Somerset House.

As regards the Public—

(1). The former law only protected the public against adulterated or mixed articles; but the new Act protects the purchaser against the delivery of

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any article which differs in substance, nature, or quality, from the one demanded.

(2). It punishes the seller who abstracts any part of an article so as to affect injuriously its quality.

(3). It prevents the sale of articles, mixed with ingredients not in accordance with the demand of the purchaser without a label indicatiag that they are mixed.

(4). It enables medical officers of health and police constables, in addition to the inspectors authorised by the former law, to obtain articles and submit them for analysis when directed to do so.

(5). It assists the Local Authority of a small district in obtaining the services of an efficient analyst by empowering them to engage the analyst of another Authority; and it enables a purchaser, in a district where there is no analyst, to obtain analyses from the analyst of another district.

(6). It compels the trader to sell a sample for analysis on demand.

(7). And, lastly, it renders the law more intelligible, and therefore more practicable, accessible, and certain.

It will be seen, therefore, that whilst some of the amendments which have been made afford to the trading community the reasonable protection to which they were justly entitled, others have rendered the law much more stringent and effectual in the interest of the public.

I am, Sir,
Your obedient servant,
(Signed) JOHN LAMBERT,
Secretary.

To the Clerk of the Peace.

Regulations to be observed in transmitting articles for analysis to the Commissioners of Inland Revenue:—

(1). The sample retained by the purchaser, as stated in sections 14 and 15 of the Act, should be carefully sealed up and secured either in paper or in a box, as the case may be.

(2). The seal used should bear a motto or device not in common use, to enable its identity to be sworn to.

(3). If sent through the post, the instructions issued by the Postmaster-General for the transmission of such samples should be carefully carried out, and the parcel should be addressed to—

THE COMMISSIONERS OF INLAND REVENUE,
Inland Revenue Office,
Somerset House,
London, W.C.

The Principal of the Laboratory.

And in addition to the nature of the contents being stated on the front of the packet, as enjoined by the Postmaster-General, the name of the place whence sent should be stated.

If dispatched by railway or other conveyance, the address above given, with the name of the place from which forwarded, will be sufficient.

(4). At the time the parcel is dispatched, by post or otherwise, a letter should be sent by post to the Principal of the Laboratory, apprising him of the transmission of the sample for analysis, and stating the nature of the alleged adulteration, and such other particulars as may be considered necessary to facilitate the examination of the sample.

CORRESPONDENCE.

MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—I would briefly reply to "E. H." that, although sulphate of the best quality, as regards percentage of ammonia and freedom from sulphocyanide, can be made from pyrites acid, it cannot, in the experience of the largest makers, be produced from this material of the orthodox "good grey" hue.

When I say pyrites, I mean "Spanish," the leading kind, and which, on account of its richness, cheapness, and abundance, has now all but driven the varieties of which "E. H." speaks out of the English market. It is quite certain that the sulphate from Spanish pyrites acid is of a brownish grey tint. I may add that years ago one of the largest and wealthiest sulphate manufacturing firms made a determined effort to produce a white or "good grey" article from this acid, but completely failed, as, indeed, all such attempts merely to improve the colour of manures deserve to do.

Had the same energy been devoted to the introduction of the dark grey sulphate, thus boldly attacking and meeting a most unfounded and unchemical prejudice, success would long ago have been achieved and a great deal of valuable money might have been saved.—I am, &c.,

ONWARD.

PS.—"E. H.'s" "good grey" from acid of other kinds of pyrites has now very little practical importance. The extensive importations of Rio Tinto (Spanish) ore have already brought down the price of pyrites 30 to 40 per cent, and it is quite clear that the owners of the Tharsis, Masons, Rio Tinto, and other Spanish mines will soon be the only pyrites people in the market. In fact, I heard a large proprietor in one of these companies say recently that the copper in the ore would pay them if they had to give the sulphur away.

"GOOD GREY" SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—Until I read "Onward's" letter, I should have pronounced it incredible that in this year of grace, 1875, makers of sulphate of ammonia for manure should be compelled by their customers to use expensive brimstone vitriol, because pyrites vitriol will not give them a "good grey" product. After this, a bucolic demand that chemists shall henceforth use the divining rod in determining the value of soils would not be very surprising intelligence.

Why, in the name of tender mercy, did not Providence give them "good grey" guano or snow-white muck?

If "Onward's" indictment of this rare piece of humbug has not sufficed, perhaps the following facts may give the *coup de grace* to the superstition:—

To farmers and all whom it may concern, let it be known that large quantities of sulphate of ammonia are produced by lixiviating the "sulphuretted oxide" of the gas works, a material always containing more or less of the compound so poisonous to vegetation—sulphocyanide of ammonium. Now, if the manufacturer take this lixiviated solution and (after adding to it sufficient gas-liquor to precipitate its iron) evaporate it to the crystallising-point, he will get a sulphate of as "good" a "grey" as can be desired; but, let it be remembered, it will contain the whole of the poisonous salt originally present in the oxide. Suppose, further, that it contains 5 per cent of the sulphocyanide, it will, upon determination for ammonia, show the required 24 per cent, and the injury to the farmer's fields will be the first indication of its worse than worthless quality.

Will it be believed, in the face of these facts, that contracts for sulphate of ammonia are regularly made without a word of reference to the sulphocyanide? I have been shown two to-day, one of them for 175 tons, in which the only conditions are "good grey" and "24 per cent of ammonia!"

If I were buying sulphate, I would say—"Good grey!" Make it as black as my hat if you like, but it must have 24 per cent of ammonia and be wholly innocent of sulphocyanide.

MID-DAY.

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ESTIMATION OF PHOSPHORIC ACID BY THE BLOWPIPE.

To the Editor of the Chemical News.

Sir,—As the above process does not seem to be included in the Report on the methods employed for this purpose by the British Association, Bristol Meeting (*vide* Chemical News, vol. xxxii., p. 159), I may be pardoned for soliciting the attention of some of your many readers to it here.

The process is based upon—

(A). The beautiful opalescence communicated to *pure boric acid* by a certain proportion (to be determined as a standard by the balance) of *pure phosphoric acid*, before the blowpipe.

(*a*). *Substances* which, thus treated, give *directly* this opalescence.

(1). Alkaline phosphates, in extremely small proportion; as, if an alkaline borate is formed, the opalescence is *dissolved* to a clear glass.

(2). Cast- or pig-iron, and sometimes wrought ditto.

(3). Phosphides of metals proper.

(4). Some *tourmalines*, *axinites*, or analogous minerals, containing many basic oxides, the trace of phosphoric acid with which is apparently uncombined.

(B). Phosphates of the "alkaline-earth" metals.

(C). Phosphates of "earth" metals, as, *e.g.*, aluminum.

(A) class opalescence is compared in a boric acid bead of 50 m.grms. placed under a lens, with the standardised phosphated boric acid bead, also of 50 m.grms., and the amount of PO_5 estimated by an ordinary calculation of ratios; the standard amount of PO_5 being about 2·5 m.grms., or in the proportion of 5 per cent, when the appearance caused is like that of a noble "opal," *i.e.*, blue by reflected, and reddish yellow by transmitted, light.

(B) class form opaque white balls (like snowballs) floating in the pellucid boric acid bead, and may be separated from that (if desired) by boiling in distilled water, which dissolves the bead, but not the balls. The latter, however, must be decomposed *in the bead*, which cannot be done (as is the case with carbonates or sulphates, &c., of these earths) with the blowpipe alone. The most ordinary and, therefore, useful examples are—

(*b*) Calcic phosphates, and

(*b'*) Magnesic phosphates.

Magnesium phosphates are (so far as my experience goes) the most obstinately coherent, and therefore difficult to decompose, of any; so that this base may be thus suspected.

(C) class remain utterly undecomposable and insoluble as white amorphous fragments in the pellucid boric acid bead under any amount of mere heating.

The latter, (B) and (C), classes are treated in the same manner, as follows:—

Hydric sulphate is the best reagent for disengaging phosphoric acid,* but to apply its solution in water brings us into the region of "wet," and out of that of purely pyrognostic analysis, to illustrate the latter of which methods alone is at present my object.

About one-tenth (in volume) of *magnesium* sulphate is therefore heated before the blowpipe in a 50-m.grm. bead of pure boric acid, and the resulting opaque white ball dissipated, and no more, by the cautious addition of crystallised potassium carbonate; for, if too much be added, an alkaline borate is formed, which dissolves a large proportion of phosphoric acid to a clear glass, and thus renders it invisible. The smallest speck of "earthy" or "alkaline earthy" phosphate now treated in this bead before the blowpipe is at once decomposed, the eliminated phosphoric acid affording the usual blue opaline matter to the bead on cooling, and a sufficient quantity of the phosphatic assay is thus added until the former is exactly equal in depth of opaline tint to the standardised bead (which has, of course, had an equal quantity, by weight, of potassium carbonate and magnesium sulphate added to it), when a sum in proportion concludes the business.

Organic phosphates—or, rather, phosphates derived from organisms—as urinary, biliary, or gouty concretions, are rather more difficult to assay, and require special treatment, as described in my work, "Pyrology," page 189.

The last equivalent of *water* (given off even by the most intensely calcined lime), communicated by nearly all substances to pure *boric acid* before the blowpipe, also tinges that with an opaline tint on cooling, though not nearly so blue or pure as that afforded by phosphoric acid; but the addition of potassium carbonate dissolves away the opalescence of the former never to return, while that of the latter returns as strongly as ever by the simple addition of fresh-fused boric acid.

It will be observed, from the above, that a *quantitative* assay of phosphoric acid is here rather suggested than detailed, and I have not, in fact, yet carried the matter out in all its details; but there can be no reasonable doubt of its possibility, and meantime, as a detective of the presence of phosphoric acid, I am willing to back this pyrological method, before competent judges, against the best (known) "wet ways"—as, for instance, Sonnenschein's—having thus detected this acid in *Lapis lazuli*, "pure" manganese binoxide, &c., where it was not supposed to exist.—I am, &c.,

W. A. Ross.

* I am not aware if this well-known fact has been applied to the treatment of patients suffering from concretionary phosphates in the bladder, joints, &c.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 14, October 4, 1875.

Results Obtained in Attempts at the Industrial Application of Solar Rays.—M. A. Mouchot.—The author's apparatus is composed of three distinct pieces—a metallic mirror with a linear focus; a blackened boiler, the axis of which coincides with this focus; a glass enclosure, which allows the solar rays to reach the boiler, but opposes their exit as soon as they have become transformed into heat-rays. The yield of a large solar heat-generator is greater than that of a small one. The whole apparatus is arranged so as to turn 15° hourly around an axle parallel to the axis of the earth, and to incline gradually to this axle, corresponding to the sun's declination. An apparatus of this kind, erected at Tours, gave the following results:—On May 8, in ordinary fine weather, 20 litres of water at 20°, introduced into the boiler at 8.30 a.m., produced in forty minutes steam at a pressure of 2 atmospheres, or a heat of 121°. This steam rapidly rose to the pressure of 5 atmospheres, a limit which it was not safe to exceed. About mid-day, with 15 litres of water in the boiler, the steam was raised in fifteen minutes from 100° to 153°—a pressure of 5 atmospheres. Hence the author concludes that in hot and sunny climates the sun's rays may be successfully utilised as a source of mechanical power.

Different Amounts of Heat Produced by the Mixture of Olive Oil with Concentrated Sulphuric Acid, according as the latter has been more or less Recently Boiled.—E. J. Maumené.—Sulphuric acid produces with certain bodies, if not with all, a disengagement of heat the greater the more recently it has been heated to its point of ebullition, 326°. It is probably the same with many bodies having, like sulphuric acid, the property of boiling at high temperatures without undergoing any chemical modification, properly so-called. These bodies,

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like sulphuric acid, undergo a slight alteration in their molecular structure, the indication of which is a change in the number of calories produced by their chemical action. The author observed this fact whilst analysing samples of oil by the process which he proposed in 1852 (*Comptes Rendus*, xxxv., p. 572): 50 grms. of olive oil, mixed with 10 c.c. of *boiled* acid, gave a rise of temperature of 42°. Previously he had never employed pure acid. Latterly, the use of a sample of this acid, which had been kept for at least two months, gave 34·5° instead of 42°. The olive oil was of known origin. Being led at first to ascribe this difference to the impurities of the ordinary acid, he added ½ c.c. of nitric acid to about 50 c.c. of sulphuric acid, when, in spite of this addition, the temperature of 34·5° was reproduced. The acid used had the specific gravity 1·845. The idea of ascribing the difference to a structural modification in the boiled acid occurred then to the author, and was confirmed by experiment. Pure acid was allowed to boil, and when a few c.c. had distilled over it was tried with the same oil, and produced a rise of 44° instead of 34·5°. Twenty-four hours subsequently the result was the same. A temperature of 326°, therefore, gives sulphuric acid a structure different from that which it possesses when it has remained for some weeks at ordinary temperatures. This modification does not seem to be indicated by its physical properties. The acid in both forms possesses not a trace of rotatory power. Chemical actions alone betray this change of structure. Olive oil is not singular in this respect, the other oils presenting analogous results. Water itself appears to give rise to differences of the same kind: 50 c.c. of water, mixed with 10 c.c. of acid recently boiled, gave a rise of temperature of 35° to 36°, but only 33° with old acid.

Existence of Ferruginous and Magnetic Particles in the Atmospheric Dust.—M. G. Tissandier.—In all specimens of atmospheric dust examined by the author he has discovered minute particles of magnetic iron ore, which he believes to be of cosmic origin.

Influence of Stripping off the Leaves upon the Vegetation of the Sugar-Beet.—M. Ch. Violette.—The author finds that the result of this operation is to diminish in a notable manner both the gross yield of the crop and the proportion of sugar, and to introduce into the juice an increased amount of mineral matters and of organic substances other than sugar.

Two New Meteorites from the Desert of Atacama, with Observations on the Meteorites hitherto found in that part of South America.—M. Domeyko.—(1.) Meteoric iron from Cachiyuyal. This meteorite weighed 2·55 kilos. On analysis it yielded—

Iron	93·72
Nickel	4·81
Cobalt	0·39
Schreibersite (0·200 Fe, 0·100 Ni, 0·085 P)	0·40
Earthy matter (0·2 Si, 0·3 MgO and CaO)	0·50
	99·82

(2.) Meteoric iron from Mejillones. It composition is—

Iron	95·4
Nickel	3·8
Cobalt	0·1
Schreibersite	0·9
	100·2

M. Reimann's Farber Zeitung, No 38, 1875.

This issue contains an article on the application of eosin in dyeing, the reproduction of which is specially reserved. There are also receipts for a fine red on cotton yarn, a pale bluish green on the same material; a rose, a Nicholson-blue, and a ponceau for silk; and a deep black for woollen piece-goods.

Les Mondes, Revue Hebdomadaire des Sciences, No. 7, October 14, 1875.

This issue contains no chemical matter.

MEETINGS FOR THE WEEK.

Monday, November 1st.—Royal Institution, 2. General Monthly Meeting.

Thursday, 4th.—Chemical, 8. "Isomeric Terpenes and their Derivatives" (Part V.), and "On the Alkaloids contained in the Aconites" (Part I.), by G. H. Beckett and Dr. C. R. A. Wright. "A Simple Form of Gas Regulator for Maintaining a Constant Temperature in Air-Baths, Water-Baths, Incubators, &c.," by F. J. M. Page. "On the Fluorides of Arsenic Phosphorus of Iodine," by R. W. Emerson MacIvor. "On Iolyl-phenyl, a New Hydrocarbon," by Thomas Carnelly. "Ethyl-phenyl Acetyline," by T. M. Morgan. "On the Presence of Liquid Carbon Dioxide in Quartz Cavities," by W. N. Hartley.

THE
QUARTERLY JOURNAL OF SCIENCE.

Edited by WILLIAM CROOKES, F.R.S., &c.

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CONTENTS.

I. Animal Depravity.
II. The Longevity of Brain-Workers.
III. On the Condition of the Atmospheres of the Planets.
IV. The Possibility of a Future Life.
V. The Channel Tunnel.
VI. The Arctic Expedition of 1875.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 832.

NOTE ON THE CHANGES IN RIVER-WATERS.

By J. ALFRED WANKLYN.

I HAVE already shown that when the Nile is in high flood the proportion of chlorine is extraordinarily low, viz., 0·23 grain per gallon, the proportion of chlorine before the Nile has risen being 1·8 grains per gallon.

As I said, when publishing these results, I expected that other rivers would exhibit analogous phenomena, only that the depression would *not* be so marked. An opportunity for testing the correctness of this anticipation has been afforded by the recent floods, and at the present moment the water of the Thames, taken by the companies at Hampton Court, contains only 0·88 grain of chlorine per gallon, the usual proportion of chlorine being 1·2 grains per gallon.

ON A NEW ACID AND OXIDE OF URANIUM.

(PRELIMINARY NOTICE.)

By T. FAIRLEY, F.R.S.E.

IN the course of a detailed study of oxygen compounds I have had occasion to investigate the action of hydrogen dioxide on salts of uranium. The action is remarkable, and takes place even in presence of much free acid.

On mixing solutions of uranic nitrate and hydrogen dioxide a yellowish white precipitate is obtained, which when washed and dried at 100° C. retains 1 atom of water, and gives numbers agreeing well with the empirical formula, NO_2,H_2O. Its real formula is no doubt some multiple of this formula. This oxide is, by its decomposition with alkaline hydrates, shown to be a compound of a higher oxide of uranium, NO_3, with uranic oxide, N_2O_3.

The sodium, potassium, and ammonium salts of this acid have been prepared. The sodium salt is readily obtained in crystals by mixing strong solutions of uranic salt with excess of hydrogen dioxide solution (5 per cent), and then adding strong sodium hydrate solution in quantity sufficient to dissolve the precipitate. If weaker solutions be used, the addition of a little alcohol will separate the sodium salt in crystalline plates. The full analyses of these compounds I shall publish shortly.

By means of hydrogen dioxide uranium may be separated from all other metals, and in acetic solutions either uranic salt or hydrogen dioxide may be used to titrate each other, using potassium ferrocyanide as indicator.

8, Newton Grove, Leeds,
November 1, 1875.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 203.)

IN a letter dated March 18, 1874, M. Landolt, Professor of Chemistry at the Polytechnic School of Aachen, confirms these statements. The use of water-gas is continued only in Cockerill's works at Seraing. At Simoni's cloth-works at Verviers the process never advanced beyond the stage of unsatisfactory experiments, although certain technological papers have asserted to the contrary. In Maestricht where the water-gas was used for some time for public purposes, it has, as Professor Landolt has been informed, failed to give lasting satisfaction, and has been replaced by coal gas two years ago (1872). Direct inquiries addressed to the municipal authorities have remained unanswered.

The above statement of the introduction of the Drummond light in English military establishments led to an enquiry being addressed to the Chemist to the War Department, Mr. Abel, of Woolwich, from whom the following courteous reply was received, under date April 20, 1874: "As regards your enquiry concerning the introduction of the lime-light in military premises I have to communicate that at the period you mention experiments were made for a short time in two of our establishments, but that the question of its formal introduction has never been seriously entertained."

The illumination of the galvano-plastic works of Christofle with water-gas was likewise of brief duration, and the process has been long ago abandoned. We are indebted to this firm for the following communication under date April 21, 1874: "In reply to your letter of the 17th we have to state that the use of hydrogen in our works came to an end in 1853 on account of certain difficulties (*inconvénients*) which presented themselves, and that we have no longer preserved the documents bearing upon the matter."

It only remained to ascertain the fate of the so-called platinum gas at Narbonne. To do this with certainty there appeared no other method than to appeal to the courtesy of the municipal authorities. The Mayor of Narbonne had the kindness to comply fully with our request, and to sign the following instructive and characteristic letter, dated March 16: "The relations of Prussia and France since the war impose upon me the greatest caution as regards inquiries. As the question, however, is one of a purely scientific nature I have handed over your letter to the Abbé Prax, chemist to the Agricultural Society of Narbonne who has for a long time occupied himself with the subject. I have the honour to enclose a copy of the memoir which he placed in my hands."

Account of the Water-gas in Narbonne from 1855 *to* 1865.

"In May, 1855, I was sent to Paris by the municipality to test the water-gas of Passy. My report was dated June 8, 1855. The town adopted this method of lighting and heating and came to an agreement with the company called the 'Narbonnaise.'

"From 1856 the Passy system was in use in Narbonne. We modified the burners in several respects, as those of Passy were not sufficiently lasting. The high temperature of the retorts occasioned from time to time the loss of a furnace, and after many losses the system of retorts was abandoned in favour of another apparatus, the "Cubilot" (Faye's apparatus). Towards the end of 1858 it was heated with wood charcoal, which soon gave place to coke on account of its costliness. At the same time we made important changes in the burners and platinum baskets, the latter of which were suspended instead of resting upon the former.

"The illumination with hydrogen is brilliant but sensitive (*délicat*). The lamps in the streets must be well closed, as a gust of wind distorts the ignited platinum wick. The dust introduces sand, which forms a silicide of platinum, and this metal ultimately assumes an injurious crystalline structure and is even partially volatilised.

"In Narbonne all care was wanting towards the end of the career of the company Narbonnaise. The manager, M. Crouzet, became a wine merchant in Paris. All superintendence was withheld, and the lighting became at last intolerable. In June, 1865, therefore, coal gas was introduced. As far as heating is concerned nothing can in my opinion compete with water-gas in convenience and cheapness."

PRAX,
Chemist to the Agricultural Society.

Narbonne, March 15, 1874.

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

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ON NOCTILUCINE, THE PHOSPHORESCENT PRINCIPLE OF LUMINOUS ANIMALS.*

By Dr. T. L. PHIPSON, F.C.S.,
Member of the Chemical Society of Paris, and of the Royal Society of Medical and Natural Sciences of Brussels, &c.

In reviewing the various phenomena of phosphorescence which are so numerous, both in the mineral world and in organic nature, it is not very difficult to convince one's self that in the great majority of well-observed cases belonging to the former, the production of light can be directly referred to electrical action, or to electrical action resulting from chemical action, and the latter mostly from oxidation.

As examples of purely electric action, may be cited the light produced in the formation and cleavage of crystals; the sparkling of boracic acid when cooling after fusion; the light emitted by benzoic acid during its sublimation; the flash of light that accompanies the cleavage of a plate of mica, when one fragment is found to be electro-positive and the other electro-negative, immediately after the operation; the light emitted when quartz pebbles are violently rubbed together, which is accompanied by an odour of ozone; the flickering scintillations observed when a mixture of sulphate of soda and sulphate of potash crystallises, when arsenious acid crystallises, when crystals of sugar or nitrate of uranium are broken, and a very great number of similar cases which it would be far too long to mention here. In fact, the more the phenomenon is observed, the more general it appears to be throughout nature.

As examples of electrical action following on chemical action, may be cited the luminosity of phosphorus, of potassium and sodium, of arsenic, sulphide of antimony, and a considerable number of cases where oxidation, or other chemical action, is intense. I have referred to all these in another place.†

In the organic world, with one exception, the luminosity of animals and certain plants can be with tolerable certainty referred to the production of the principle which I have termed noctilucine. The one exception is when the production of light can be traced also, with the greatest probability to electrical action. This is evidently the case with the sparkling radiations which are occasionally seen round the flowers of the marygold and several other plants at a certain period of their growth, when the atmospheric conditions are favourable. The phenomenon is coincident with the rupture of the anthers and the ejection of the grains of pollen. We have other examples of a similar production of light resulting from the sudden rupture of plant tissue in dry weather.

Noctilucine is a peculiar organic principle which appears to be very widely spread through nature. It is the cause of the light of the glow-worm, the scolopendra, the fireflies, the pholas, and numerous other luminous animals, both during life and for a certain time after death. The first allusion to the existence of this substance occurs in my note, "Sur la Matière Phosphorescente de la Raie," published in the *Comptes Rendus* of the Paris Academy in 1860, where I have spoken of it as a peculiar organic matter devoid of phosphorus, but shining in the dark like that element itself. It was found, by the most careful tests, to contain neither phosphorus nor phosphoric acid. It is again alluded to in my work on "Phosphorescence," published in London in 1862 (p. 103), and finally in my paper, "Sur la Noctilucine," in the *Comptes Rendus* of the Paris Academy for August 26, 1872 (p. 547). The same substance is noticed again, exactly one year later (August 25th, 1873), in the same publication, by Professor Ch. Robin and M. Laboulène.

Noctilucine is not only the cause of the phosphorescence of dead fish and animal flesh of every kind, but it is secreted by living animals, such as the glow-worm, the scolopendra, the fireflies (*Elater*), the common earth-worm, and by a very considerable number of others, amounting probably to many hundred distinct species, that are seen to shine in the dark. It appears to be produced also by certain living plants—*Agaricus*, *Rhizomorpha*, and *Euphorbia* (?)—and occasionally in the decomposition of vegetable matter (putrid fermentation of potatoes, &c.).

At the ordinary temperature of summer in this climate, noctilucine is a fluid nitrogenous substance, slightly viscous or oily in appearance, that can be mixed with water, but does not dissolve, though the watery liquid can be filtered; its specific gravity is slightly less than that of water; its colour is white, when impure yellowish white, and when decomposed becomes brown.

When recently extracted from a living or a dead animal it invariably contains a certain quantity of water, and possesses a slight odour recalling that of caprylic acid; it is insoluble, or only slightly soluble, in alcohol and ether, but mixes with them and with glycerine. It is dissolved and easily decomposed by acids and alkalies, and when heated with potash it evolves ammonia.

Alcohol, ether, and especially mineral acids, extinguish its light very readily. When left for some days in contact with pure water, it enters into decomposition, and evolves after a time an ammoniacal odour of putrid cheese.

As long as it is moist, noctilucine absorbs oxygen and evolves carbonic acid; but, when left in the air, it dries up into thin semi-transparent films quite devoid of structure of any kind, and then resembles the substance called *mucine*, which has been obtained from garden snails and other Gasteropoda.

When recently obtained, noctilucine is highly phosphorescent, and this production of light is evidently due to oxidation in contact with the air. Numerous experiments leave me in no doubt of this. It will even shine in water when air is present in that liquid. As already stated, it is slightly soluble in water; at any rate, it mixes so intimately that the liquid, after filtration, is luminous in the dark when stirred, but as the oxidation of the noctilucine proceeds the water becomes turbid or milky and ceases to shine; it soon after enters into decomposition, evolving first an odour of propylamine, and afterwards an odour of putrid cheese.

In oxygen gas, the light emitted by noctilucine is rather more vivid than in the air, but it is more brilliant still during a south-west wind that carries much ozone. The production of light ceases when oxidation is completed, but, when the slightest quantity of air adheres to it, noctilucine will shine for a little time in moist carbonic acid.

In the heat of summer, noctilucine occasionally gets separated from the bodies, living or dead, of various marine animals, in sufficient quantity to form a thin oily stratum on the surface of the water of stagnant pools or coves on the sea coast. This oily layer gives out light when stirred so that the air can come well in contact with it, the surface being completely oxidised and having ceased to shine. Near the pier at Dover, and at the back of the port at Ostend, I have seen many square yards of water covered with this film of noctilucine in June and August; it contained few or no luminous animals, and in the evening shone when stirred. The same thin layer will form, in the course of twenty-four hours, on water in which noctilucine obtained from dead fish has been dissolved, or rather mixed; and I possess four observations of the same formation occurring upon urine. In all these cases light is emitted from the film whenever it is stirred so that it comes thoroughly in contact with the air; after repeated stirring when oxidation is completed, the light ceases to be seen.

According to some recent observations upon the fireflies of the West Indies, by Professor Charles Robin and Dr. Laboulène (*loc. cit.*) it appears very probable that noctilucine gives rise to uric acid, or urates of ammonia

* Read before the British Association for the Advancement of Science, Bristol, 1875.

† "Phosphorescence; or the Emission of Light by Minerals, Plants and Animals." London, 1862.

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and soda, in its final decomposition, as these substances are invariably found in the phosphorescent organs. The characters of the luminous substance, as investigated by them in these exotic insects, correspond to those of the noctilucine extracted by me from fish, and from the glow-worm and scolopendra. These gentlemen have studied the anatomy of the luminous organs with almost as much care as Professor Paoli Panceri has studied these organs in polypes and other lower animals, in a series of remarkable papers read to the Royal Academy of Naples in 1872, and profusely illustrated.*

In phosphorescent animals noctilucine is secreted by a special organ, just as bile is secreted by the liver, and this luminous organ is as special in its character as is the electric organ of the *torpedo* or *gymnotus*. The substance is produced, and gives light, as fast as it is required. But noctilucine is also produced under certain conditions of temperature and moisture by dead animal matter, such as flesh, blood, and sometimes in urine. Whatever may be its origin, it always gives the same kind of light; the spectrum of this light really spreads from C to a little beyond F, when the phosphorescence is very vivid (as in the *Elaters* of the West Indies), but its brightest portion lies between the lines E and F, and in most cases this portion only is visible, and the light appears nearly monochromatic. It has no lines nor bands of absorption. As far as I have hitherto been able to examine it, noctilucine, whether extracted from dead fish, from the glow-worm, or the scolopendra, possesses the same chemical properties. It is secreted in a state of great purity by *Scolopendra electrica*; and in the month of September it is possible, by causing several of these myriapoda to run about on a flat glass dish with vertical slides, to collect enough of it to examine its principal characters. From the luminous organ of *Lampyris noctiluca*, and from the surface of phosphorescent fish (stockfish, mackerel, herring, &c.), it can also be obtained, in a less pure form, by collecting on a damp filter the luminous matter washed or scraped from the surface, or, better, by stirring the shining matter with water and allowing the liquid to stand in a narrow vessel till the next day, when the noctilucine will form a layer upon the surface that can be separated; but it is already partially decomposed.

The experiments I have made with this substance for several years past, whenever I have had an opportunity of observing it, lead me to the conclusion that it is of a basic or neutral, rather than an acid, nature; and, though I have not yet obtained it either pure enough or in sufficient quantity to investigate it very minutely, I believe that noctilucine belongs to the propionic series. It may, perhaps, hereafter be proved to be a cyanic derivative of propylic aldehyd belonging to the same class of bodies as *leucine* (cyanhydric derivative of amylic aldehyd) or *creatine*. This would also tend to account for the final resolution of noctilucine into *urates* of soda and ammonia, which are almost always found in the luminous organs of various animals.

The secretion of noctilucine by the higher classes of luminous animals, such as the insects (*Elater*, *Lampyris*, &c.) and myriapoda, is, doubtless, to a certain extent under the influence of the nervous system, which gives them the faculty of causing the light to cease. In this case the secretion is arrested for the time. (It has been long known that the eggs of the glow-worm shine for some time after they are laid, so that they also must contain a small quantity of noctilucine.)

In animals much lower down in the scale, such as the little *Noctiluca miliaris* of the English Channel, the polypes, medusæ, &c., it appears to me quite evident that there exists also a *special organ* for the production of noctilucine; and even here, where we find scarcely any indication whatever of a nervous system, the secretion of this luminous matter often appears to be subject to external influences.

London, October 28, 1875.

* The researches of these distinguished physiologists have confirmed most completely my earlier conjectures as to the special character of the luminous organs of phosphorescent animals even those lowest in the scale of animal life.

ON THE

ADOPTION OP A SYMBOL TO SIGNIFY THE APPLICATION OF HEAT FOR USE IN EQUATIONS OF CHEMICAL REACTIONS.

By W. H. SYMONS, F.C.S., Norwich.

For some time past certain signs have been used in equations to show whether the substances there enumerated are in a solid, fluid, or gaseous state. Thus a short line placed above a symbol or formula indicates that the body is either a liquid or a salt in solution; a similar stroke placed below shows that it is a solid substance or an insoluble precipitate. Of course this sign must not be confounded with that which marks the abbreviated formula of a compound radical, as in this case the line is only extended over that portion of the formula which constitutes the radical. $H_2\overline{O}$, $\overline{Et}HO$, $\overline{HA}$, $H_3\overline{Cl}$, $H_2\overline{T}$, are well known examples of this abbreviation.

The symbol I propose to use as indicatory of heat is either a star, $<^{\wedge}_{v}>$ or a simple cipher $(\,)$. I think the latter to be preferred, as it is more easily written, and the degree of heat required can be placed inside. Thus—

$$\underline{2HgO} + (100^\circ) = \overline{Hg_2} + \overset{+}{O_2}.$$

$$\underline{3MnO_2} + (900^\circ) = \underline{Mn_3O_4} + \overset{+}{O_2}.$$

$$\underline{2KClO_3} + x\underline{MnO_2} + (400^\circ) = 3\overset{+}{O_2} + \underline{2KCl} + x\underline{MnO_2}.$$

$$\underline{MnO_2} + 4\overline{HCl} + <^{\wedge}_{v}> = \overset{+}{Cl_2} + \overline{MnCl_2} + 2H_2\overline{O}.$$

$$4\overset{+}{H_2O} + \underline{Fe_2} + (900^\circ) = 2\underline{FeO_2} + 4\overset{+}{H_2}.$$

I have used the above signs for several years, and having found them useful myself, I believe that others may do the same, and I think that any legitimate aids to memory are calculated to discourage cram.

October 7, 1875.

[Signs and symbols to be of practical use should always be capable of being expressed in ordinary printing types, otherwise there will be little chance of their general adoption.—*Ed. C. N.*]

A NOTE IN RELATION TO THE

MASS OF METEORIC IRON THAT FELL IN DICKSON COUNTY, TENN., IN 1835.

By J. LAWRENCE SMITH,
Louisville, Ky.

Every metallic particle in the interior of a meteoric stone is a complete miniature type of the large masses of meteoric iron which have been discovered in different parts of the world, but not seen to have fallen, leading to the natural conclusion that they must have fallen at periods anterior to the date of their discovery. And it is an interesting fact in celestial meteorology, that the stony meteorites, with their little particles of metal, fall with comparative frequency. Yet the fall of iron masses free from earthy matter are so rare that we have but four authenticated cases: that of Agram, in Croatia, in May,

1751; that of Braunau, Bohemia, in July, 1847; that of Victoria, Africa, in 1862; and the one which now forms the subject of this communication, which fell on the 1st of August, 1835, near Charlotte, Dickson County, Tenn., U.S.; lat. 36° 15', long. 87° 22'. A short description was given by Professor Troost, of Nashville, and published in *Am. Journ. Sci.*, 1845. Professor Troost dying very shortly after that period, his cabinet of minerals and other objects of natural history were placed in boxes by his executors, and have remained thus until within the past few months, when they passed under my control. The scientific world knowing so little of this meteoric iron, I at once proceeded to its examination; and as only a small part of one end, weighing two or three hundred grammes, had been cut off, it was easy to restore that from a drawing, and obtain a perfect cast of the mass, which had been finished in all respects to resemble the original, both in form and colour. My reason for making the present communication is to call attention to the remarkable features of this most interesting meteorite, which, although it is forty years since it fell, has not been seen by a half dozen scientific men.

This meteorite fell during the day-time, in a field where several persons were at work, frightening a horse attached to a plough, who ran wildly about the field dragging the plough after him. It struck the ground at the root of a large oak, descending at rather an acute angle, and burying itself in the roots of the tree. The sky was cloudless, and a noise was heard preceded by a vivid light. Other particulars connected with its fall, as well as a description of its size and form, have been already published by Professor Troost. It is of an elongated kidney shape and remarkably symmetrical form, the metal being bright and almost polished on many parts of the surface, and it has remained in this condition ever since it was discovered, although exposed to such atmospheric conditions as usually rust and tarnish iron; it is in this respect unique among meteoric irons, as well as in another particular first noted by Professor Troost. Although to the naked eye the surface has the appearance of smooth cast-iron, the smoothness of the surface in many parts disappears when examined through a lens; it is then seen to have a reticulated surface, formed by the edges of thin laminæ of metal, separated from each other by an apparently semi-fused or slaggy matter. These laminæ running in an inclined position into the mass, intersect one another at angles of 60°, and forming equilateral triangles, would divide the mass into regular octahedrons. The accompanying photograph from a drawing will better exhibit these lines very much magnified.

Another noteworthy fact in connection with this iron (which is soft and tough) is that, when cut and polished, it will resist the tarnishing effects of the ordinary vapours of the laboratory, as I have pieces which have been thus exposed for several months.

By the agency of heat or acid the Wiedmannstätian figures are developed with exquisite beauty, not equalled except by three or four known meteoric irons. In connection with these figures I will call attention to the delicate parallel lines inside of these figures, which I pointed out several years ago as being peculiar to certain of the irons, they being not contained in all Wiedmannstätian figures, and which I designate by the term "Laphamite markings."

This iron is not absolutely compact, for one can trace, even with the eye, minute cavities which are distinctly visible with a lens; but I have not yet been able to detect any schreibersite either on the surface or on the interior of the mass.

Its specific gravity is 7·717.

On analysis it was found to consist of—

Iron	91·15
Nickel	8·01
Cobalt	0·72
Copper	0·06

No trace of sulphur was detected, and so minute a trace of phosphorus that only a few exceedingly small crystals of phosphate of magnesia and ammonia could be discovered in the test made with a gramme of the iron, representing only a small fraction of a milligramme of phosphorus. In fact, I have never yet analysed a meteoric iron containing so little phosphorus. In regard to the gaseous contents of this iron, the following were the results obtained by Prof. W. Wright, who made an examination of them at my request:—

"The iron being exposed to a red-heat gave a little more than twice its volume of gas. It can be estimated as 2·2, without an appreciable error. It did not appear to be given off readily, and doubtless a larger portion would have been obtained if the iron had been in a more thoroughly divided state. An analysis of the gas gave—

H	71·04
CO	15·03
CO_2	13·03

There did not appear to be any appreciable quantity of nitrogen."

It is a question of no small interest, in connection with the fall of meteoric irons, whether or not they are heated to a sufficient degree of intensity to fuse the surface of the metal. The present meteorite would appear to solve this question in the negative; for if the surface had been melted the delicate reticulated structure, which is discoverable by the glass, would have disappeared, and it would have had an irregular melted exterior. In the present case this oxide exists on the edges and between the striæ, which serves to show that the surface of the iron, although not melted, was nevertheless intensely heated, and had been preserved from fusion only by the rapid conduction of the heat from the circumference to the centre. And this should be the case with nearly all, if not all, the masses of iron which have fallen.

The Braunau iron was not near the point of fusion,—otherwise it would have set fire to the rafters of the house in which a part of it was imbedded at the time of its fall, and the surface of that iron precludes the idea of its having been fused. If this generalisation of iron be correct, it has an important bearing upon the hypothesis of the manner in which the Ovifak iron (supposing it to be meteoric) penetrated the basalt in scattered particles just at the time of the outflow of the basalt in a plastic state; for if the iron was not melted in its passage through the air, it could not have penetrated the basalt in such a manner that the particles are completely surrounded by terrestrial basalt. This fact in connection with many others lead me more and more strongly to the conviction, in common with some others, that the Ovifak iron is terrestrial.

On the whole, the iron just described is the most interesting specimen of meteoric iron yet known.

ON THE ESTIMATION OF PHOSPHORIC ACID.

By E. W. PARNELL, F.C.S.

Chemists and others interested in the analysis of phosphates must, with myself, feel much indebted to Mr. Ogilvie for his elaborate and valuable series of experiments, the account of which he publishes in the Chemical News, vol. xxxi., p. 274. Mr. Ogilvie seems quite to have established the fact that accurate estimations of phosphoric acid by precipitation with magnesia cannot be effected in the presence of notable quantities of some salts of ammonia, especially the citrate and oxalate, and that even a large proportion of chloride is objectionable.

I do not, however, agree with Mr. Ogilvie in considering that it is impossible to obtain an accurate result unless a large excess of the precipitant be avoided; my experience is that the purity of the precipitated double salt depends, not on the proportion of magnesia employed, but upon the strength of the solutions and the manner in which the

precipitation is conducted. If the solutions be not too concentrated and the magnesia mixture be added slowly, with constant stirring, the analyst need never fear an excess of base carried down; on the other hand, if the reverse be the case, an impure precipitate may be obtained with only a small excess of magnesia.

The following are a series of estimations of phosphoric acid in which varying quantities of "magnesia mixture" were employed, other conditions being the same. I measured off quantities of a solution of phosphate of soda, added a small quantity of chloride of ammonium and ammonia, diluted the resulting mixture to about 100 c.c., and then dropped in slowly a measured quantity of the magnesia mixture with constant stirring. The precipitates, after standing, were filtered off over a vacuum, so as to effect the washing with a minimum amount of ammonia-water, for which I made the usual allowance. The figures under "magnesia mixture" represent the proportion to that necessary to exactly precipitate the phosphoric acid.

Phosphate Solution.	Magnesia Mixture.	$2MgOPO_5$. Grm.
25 c.c.	1·2	0·2021
25 ,,	1·2	0·2024
25 ,,	1·4	0·2030
25 ,,	1·4	0·2023
25 ,,	1·8	0·2028
25 ,,	2·0	0·2028
25 ,,	2·5	0·2025
25 ,,	3·2	0·2021

The solution, before precipitation, should not contain much more than 0·1 grm. of PO_5 per 100 c.c.; and I prefer a "magnesia mixture" of such strength as would yield about 0·02 grm. of $2MgOPO_5$ per c.c. I observe that Mr. Ogilvie's solution is about three times as strong as this.

NOTICES OF BOOKS.

Medical Politics, being the Essay to which was Awarded the First Carmichael Prize of £200 by the Council of the Royal College of Surgeons, Ireland. By Isaac Ashe, M.D., &c. Dublin: Fannin and Co. London: Longmans and Co. Edinburgh: Maclachlan and Stewart.

We have here an able suggestive essay dealing directly, it is true, with the status of an honourable profession, but having an important, though indirect, bearing upon the interests of science and the public welfare. We do not, of course, consider ourselves as in any way the organ of the medical body: but, as our readers will perceive, all Dr. Ashe's remarks on the imperfect professional organisation of medical practitioners, and its consequent evils, applies with a terrible *a fortiori* to chemists who have no organisation at all. Our author shows that among the "three learned professions" of old tradition—there have arisen other professions now not a shadow less learned—Medicine holds decidedly, in public estimation, the lowest position. In an article on this subject in the *Athenæum*, in August, 1868, the remark is made that "the difference in position between the well-beneficed rector and the country practitioner is so great that there is really no comparison between them." This, Dr. Ashe justly observes, "states things as they are, not as they ought to be." "We have known," he adds, "the major of a militia regiment, a man who prided himself on belonging to one of the county families, and who had been high sheriff of his county, give a physician the fee of £1 for five visits, during which his child's life had been saved, and which had cost the doctor, in actual cash out of pocket, the sum of 15s. . . . We have known, in the same district, a lady of title employ a physician to attend her family, sending for him in much consternation, and with great urgency, and when the attendance was over bow him out without any fee whatever, and never send him any afterwards, as he might suppose she meant to do. But what redress has he? To appeal to a court of law, as things are at present, would drive him out of the county. Nor is this estimate of the value of medical services confined to the country districts, or to the sick public only. The fee allowed to a physician by the legal functionaries for spending his whole day in a court of law, whether at Quarter Sessions or Assizes, is just one guinea. If he lives at such a distance as to preclude his returning the same night, he may claim a second to cover hotel charges, &c., but if living in the town, one guinea is the whole sum for the entire time. It signifies nothing what his other practice may be, nor how much he may lose meantime; and we have known a man permanently lose the practice of a family through his being detained at a distance in a court of law."

Surely such facts need no comment. But more remains. "In the case of a physician who has to undertake a dispensary we must add to such social slights the petty insolence of the village publican who writes P.L.G. after his name with as much pride as if it were K.G., and takes upon himself to belabour the doctor with insolence about his cases if he meets him upon the road; the orders of the parish administrator or his curate, who are not even guardians, or on the dispensary committee, but who know that the doctor dare not reply to them under penalty of dismissal from his post; the difficulties even with the relieving officer, who will venture to dispute the doctor's diagnosis of a case, as in an instance which lately obtained some notoriety." This is certainly a disgusting picture. We fear "Bumbledom" is even more rampant in Ireland than in England, though we must never forget that we have in this country one rural P.L.G., and M.P. to boot, who conceives it his especial mission to adjudicate on the "competence" of Public Analysts.

For the evils glanced at above Dr. Ashe proposes the adoption of a more perfect organisation, and the limitation of the numbers of the profession. At the same time, with a somewhat questionable consistency, he rather favours the modern notion of "medical women." Now, save in such very exceptional spheres as the higher grades of literature, the fine arts, and the stage, wherever female labour has been introduced one of its most striking consequences has been a decline both in the amount of remuneration, and in the *status* of the calling.

We cannot help asking what would Dr. Ashe say if medical men had to encounter the competition, not merely of those who accept under-paid appointments, but of such as offer to undertake such appointments without any remuneration at all? What would he say if the physician were not merely dictated to and interfered with, but if the members of other professions sought to encroach upon his sphere of action? Yet such, and no other, is the present position of the "analytical and consulting chemist."

Dr. Ashe's essay is worth the heedful perusal of many besides medical men.

CORRESPONDENCE.

REPORT OF THE BRITISH ASSOCIATION COMMITTEE ON THE ESTIMATION OF POTASH AND PHOSPHATES.

To the Editor of the Chemical News.

Sir,—In Chemical News, vol. xxxii., p. 192, "Chemicus" waxes wrath in the matter of the "well-known firm of chemists" who refused to give any information to the British Association Committee. I am afraid "Chemicus" has hitherto looked upon this and kindred matters in a wrong light, and has also taken a very narrow-minded view of the subject. It is, no doubt, very laudable and praiseworthy for scientific men to give their services, their time, and their brains to those who have been found trustworthy and willing to work and co-operate in scientific

matters, and in matters of pure science there is, I think, no one who would object to this. In determining the true atomic weight of the elements, the coefficients of expansion of liquids, the solubilities of various salts, the specific heats of gases and vapours, the examination of new forces; these are matters upon which men of science do freely interchange their views. But there is a dearth of workers in these fields; for it is well known that such work does not bring grist to the mill, at least to many.

When we come to the subject of analytical chemistry, it is a different matter; those who pursue this branch for the love of the thing generally submit all processes used to a most searching examination before they are used, and those analysts who care for a reputation generally do the same thing.

Now, I ask "Chemicus," do *all* the present analytical chemists submit the processes they use to this rigorous examination? Do they all care about using pure chemicals? Or, how many of them know all the peculiarities of the substances upon which they operate? It is not so much a faulty method of analysis which causes the discrepancies between analysts, but rapid and rule-of-thumb working and a principle of don't care, as long as the fees come rolling in.

It is still in the remembrance of a few how two analysts differed 3 per cent in a sulphur estimation in pyrites; how a sample of soda-ash of 47 per cent was certificated 50 per cent by a firm of analysts in a western port of England: how the same firm certificated a sample of bleaching-powder as 33·5 per cent, when it really contained over 35 per cent; how one analyst found 3·06 per cent of lime in a phosphatic material when it contained 33·6 per cent; how another actually forwarded by post a certificate of the strength of a sample of salt-cake before he actually received the sample; how a Public Analyst found 30 per cent of roasted acorns in coffee, and then excused himself that his apparatus (*sic*) for this particular estimation was out of order; and it is also to be remembered how a Professor in a College will undertake the estimation of chlorine in bleaching-powder for a shilling per sample if a sufficient number be sent at once. This is trading with a vengeance—small profits and quick returns. How another will make a partial analysis of soda-ash, viz., a determination of the alkali and caustic, for half-a-crown; how a druggist's apprentice issued a list of fees in a town near Birmingham, he never having made a quantitative analysis before this and having at the time no apparatus to work with. But enough of this. Can "Chemicus" expect real analysts to work for the possible benefit of such men as these? No. The profession of the analytical chemist is rapidly deteriorating, and the practice of making a process easily workable by "unpractised persons" is beginning to exert its deleterious influences.

We are too fond of making mechanical chemists chemists, or rather without thought and judgment.

The general plan seems now to be to set down a process according to an invariable rule, and put this into the hands of "unpractised persons," saying, thus far shalt thou go and no farther. This unpractised machine may run on until some variation is required in the ordinary manipulation. But then does it break down? Oh, no! not till it has broken down something else, like a locomotive or a coach once in motion and without a driver.

We have high and low analysts; analysts weighing impure precipitates, while others are leaving that in solution they ought to weigh; some giving false certificates, others giving certificates on samples never examined at all; some detect alum in bread where alum there was none; and another possesses an apparatus for detecting roasted acorns. In fact, a general muddle is made, but with those who are conscientious and take care to rigidly examine every process they use.

The number of analytic chemists is enormously on the increase; and, taking the case of private practices, this really means less individual work and lower fees than formerly. It cannot be done, Sir; it cannot be done. Rapidity and accuracy do not generally go together; and, what with the fees in some districts being so low, a practice cannot afford time for investigation or to pay an investigator.

Can we expect *real* chemists to give the information they have obtained at the expense of time, labour, brains, and money, at least willingly, to those who have helped to bring down the profession to such a low ebb as it is now at.

I think the reply of the "well-known firm of chemists" a very reasonable one; and, although I am always ready to help a deserving lame dog over a stile as far as it lies in my power, yet there are many clumsy and unscrupulous fellows who would get no assistance from me, as also from many others of my way of thinking.

Has "Chemicus" anything to publish on analytical work? Those who are on the look out for information would, doubtless, be glad to see it. I shall be glad to hear that "Chemicus" has published any researches on analytical work: or is he only thirsting for information, he being one of those who have not yet perfected their processes?

The world, as a rule, esteems not those who give their services so free—people do not believe in such universal philanthropy; and, as to exchange of views in matters relating to pure science, let "Chemicus" reflect, and remember that, after all, it is not pure science, but money-making, which is the chief object of analytical chemistry, including the estimation of potash salts and phosphates.—I am, &c.,

XYLO.

MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—I cannot agree with Mr. Esilman in thinking that his process of converting sulphocyanide of ammonium into the sulphate of ammonia "is an easy and inexpensive method." I look upon it as a wasteful, dangerous, and expensive process, for every ton of the sulphocyanide would require nearly 1 ton of acid at 110° Tw.; for in some cases the percentage of sulphocyanide is more than the sulphate, as, for instance, in a case which I have just had myself, where the sulphocyanide was 91 per cent: to convert this into sulphate we should require nearly £200 worth of sulphuric acid, and then only make about 79 tons of sulphate of ammonia, whereas if the sample were distilled with hydrate of lime we should obtain about 158 tons.—I am, &c.,

J. CARTER BELL.

20, East Corridor,
59, Mark Lane, London.

MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—As a sulphate with 24 per cent of ammonia, and of a "good grey" colour, but containing a considerable proportion of sulphocyanide, can be made with facility from the "spent oxide of the gas works, it becomes important to know what is the real influence of sulphocyanogen compounds upon the farmer's crop.

The Consulting Chemist of the Royal Agricultural Society, in his Report for 1873, referring to the sulphate produced from this material, says that he finds most of the samples "contain appreciable quantites of sulphocyanide of ammonium—a salt which exerts a most pernicious influence upon vegetation, even if it is applied to the land in very small quantities." He adds—"Some preliminary experiments which I have made, with the view of testing practically the effects of sulphocyanide of ammonium upon plants, have shown me that it is the most powerful poison to wheat, barley, and cereal crops with which I am acquainted; and I am inclined to think that as little as 10 lbs. per acre of sulphocyanide of ammonium,

in a top-dressing of sulphate of ammonia, will injuriously affect the young barley or wheat crop. The same and similar poisonous cyanogen compounds occur not unfrequently in gas-lime and other refuse materials obtained from gas works, and used occasionally for manuring purposes. To my knowledge great mischief sometimes is done by applying certain refuse materials from gas works to grass land; and I am inclined to think that the cause of the mischief may be traced—in perhaps not a few cases—to the cyanogen compounds which occur in some refuse materials from gas works. I would therefore recommend great caution in the application to the land of waste products from gas works, and suggest that such products should be carefully examined for cyanogen compounds before they are used for manuring purposes."—I am, &c.,

A. Esilman.

MANUFACTURE OF WHITE CAUSTIC SODA.

To the Editor of the Chemical News.

Sir,—I have only just read Mr. Davis's interesting articles on the "Manufacture of White Caustic Soda," and should feel much obliged to him if he would, through the medium of your valuable journal, state whether the "lime mud" he mentions, in connection with the causticising operation, is used in the black-ash mixture in its moist state, or whether it is first dried. If the former, whether the moisture it contains does not so reduce the temperature of the furnace that the cost of the extra slack necessary to overcome that reduction does not neutralise the economy of using the lime mud? I should also be glad to hear from Mr. Davis whether, in his experience, he has found that the furnace-men are willing to work a large proportion of lime mud in a charge at the same rate of wages that they will work limestone?—I am, &c.,

Enquirer.

November 2, 1875.

MANUFACTURE OF WHITE CAUSTIC SODA.

To the Editor of the Chemical News.

Sir,—I have read with much interest the admirable articles published in your journal on the "Manufacture of White Caustic Soda," by Mr. G. E. Davis. For the valuable information contained in them I am sure I am much indebted to him. Now I wish to ask a question relating to the way in which some of the analytical results placed so fully before us were obtained; and this not only for my own information, but for that of other chemists also who may be at a similar loss. Would Mr. Davis inform us what process he used for the separate estimations of all the sulphur compounds in some of his very elaborate analyses—say the analysis of the red liquors from the black-ash pans (Chem. News, vol. xxxii., p. 212). How was a polysulphide of sodium estimated in the presence of such an enormous excess of sodium hydrate? How were the bisulphide, sulphide, sulphite, hyposulphite, and sulphate severally estimated? And, lastly, how were the cyanogen compounds determined? I have been quite unable to obtain information upon a method for the estimation of *all* these compounds in presence of each other, and any hints upon the subject of this by no means easy chemical problem would much oblige.—I am, &c.,

G. P.

Liverpool, November 2, 1875.

THE MINERALOGICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—The Mineralogical Society of Great Britain and Ireland now numbers sixty members, and includes five Fellows of the Royal Society, thirty of the Geological, twelve of the Chemical, &c., besides representatives of the Geological Societies of Edinburgh, Glasgow, Dublin, &c. New names are coming in every day—mostly, I believe of real workers in some branch of the science. London and its neighbourhood is represented by fifteen members, Cornwall and Devon by thirteen, the North of England by eight, &c., so that there will be no difficulty in forming local sections for mineralogical work.

A General Meeting will be called very shortly, for final adoption of Rules, &c. In the meantime I shall be glad to hear from gentlemen who may be desirous of obtaining information as to the objects, &c., of the Society.—I am, &c.,

J. H. Collins, Sec. *pro tem.*

Truro, October 30, 1875.

CRYSTALLOGRAPHY.

To the Editor of the Chemical News.

Sir,—I shall be greatly obliged if any of your readers will inform me, through your journal, what substances other than the minerals albite, axinite, Labradorite, and oligoclase they have observed to crystallise in any of the following forms, viz.—The oblique spheroid, the doubly-oblique spheroid, the doubly-oblique rectangular prism and pyramid, and the doubly-oblique rhombic prism and pyramid.—I am, &c.,

T. A. Readwin.

Liverpool, November 1, 1875.

NOTES UPON SUGAR ANALYSIS.

To the Editor of the Chemical News.

Sir,—In a letter signed "Beet" (Chem. News, vol. xxxii., p. 145) attention has been drawn to the remarkable similarity, and even identity, both in idea and expression, between Mr. Stewart's paper on "Sugar Analysis" (Chem. News, vol. xxxi., pp. 212 and 223) and papers written by other writers upon the same subject who wrote prior to Mr. Stewart. I have also observed this similarity, and, as an example, I enclose extracts from a paper by Dr. Wallace, written in 1869 (*Journ. Chem. Soc.*, new series, vol. vii., p. 100), and, side by side, extracts from Mr. Stewart's paper; and it will be seen at a glance that both columns are almost identical.

No answer has yet appeared to the letter signed "Beet," although more than a month has now passed since that letter was written. I think it right that Mr. Stewart should satisfy persons who are interested in this question as to whether this similarity is accidental or otherwise.—I am, &c.,

Cane.

October 26, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 15, October 11, 1875.

Rotatory Polarisation of Quartz.—J. L. Soret and E. Sarazin.—Not adapted for abstraction.

New Note on Processes of Magnetisation.—M. J. M. Gaugain.—After the removal of the magnets, the magnetisation of the middle portion of the bar is weakened in case of perpendicular magnets by the reaction of the parts lying beyond the points of contact. On the contrary, in the case of oblique magnets, the magnetisation of the middle part is strengthened by the reaction of all the other adjacent parts. Hence we may conceive that the inclination of the magnets may increase the permanent magnetisation of the middle part of the bar, although decreasing its temporary magnetisation.

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Researches on the Ammonia Contained in Sea-Waters, and in those of the Salt-Marshes of the District of Montpellier.—M. Audoynaud.—The author has made use of a standard solution of oxalic acid, of which 10 c.c. were saturated by 1·7 milligrm. of ammonia. The alkaline liquid was a dilute solution of potassa. He found in the sea-water amounts of ammonia, capable of being driven off by magnesia, varying from 0·16 milligrm. to 1·22 milligrm. per litre. But sea-water contains no ammonia in a volatile state, and consequently does not exhale any. The water of the salt-marshes gave amounts of ammonia varying from 0·00 to 0·81 milligrm. per litre.

Commercial Analysis of Sugars, and on the Influence of Salts and of Glucose on the Crystallisation of Sugar.—M. Durin.—In the commercial analysis of sugars it is not sufficient to determine the mere quantity of pure sugar present. It is needful also to know the amount of certain foreign bodies which have the power of interfering with the crystallisation of sugar in the process of refining. Salts hinder crystallisation to the extent of four or five times their own weight. Glucose has also been considered as obstructive to the extent of twice its weight. The author finds that crystallisable salts do not interfere with the crystallisation of the sugar, but that the formation of treacle is due to organic matters and deliquescent salts present in the juice of the cane and the beet. Nevertheless, the assumption that each part of saline matter will hinder the crystallisation of 4 parts of sugar, though it is founded on a theoretical error, gives results satisfactory in industrial practice. Glucose, contrary to the usual opinion, does not interfere with crystallisation.

Electro-Conductibility of Pyrites.—M. H. Duffet.—The author contends that the conductibility of iron pyrites is a true metallic conductibility, very variable according to the physical structure of the specimen, but which, in a given crystal, is affected neither by the direction, nor the intensity, nor the duration of the current.

Telluric Minerals Recently Discovered in Chili.—M. Domeyko.—Tellurium has been found in Chili in at least two forms. Telluric silver (bessite) is found, containing—

	I.	II.
Tellurium	37·6	38·0
Silver	58·0	56·6
Lead	4·7	5·4
	100·3	100·0

This mineral is auriferous, but the proportion of gold does not exceed 0·00025. It is found in grains weighing from 3 to 5 decigrammes, of a blackish steel-grey, very fusible, and readily attacked by nitric acid. Tellurate of lead is recognised by its beautiful light yellow colour.

Central-Blatt fur Agrikultur Chemie,
Heft 7, July, 1875.

Amount of Ammonia in the Atmosphere.—A. Lévy and H. M. Davy.—The ammonia contained in the rain-water was found to amount annually to 13·483 kilos. per hectare of land. To this must be added a somewhat smaller quantity of nitric or nitrous acid. Nevertheless the total amount of combined nitrogen per hectare is small, and does not suffice to explain the excess of nitrogen withdrawn by certain crops from the soil.

Comparative Temperatures during Frost Beneath a Soil Covered with Turf and a Bare Soil.—M. Becquerel and E. Becquerel.—The temperature of the air during these observations ranged from 0° to −12°. That beneath the ground covered with turf never sank as low as 0°, whilst that beneath bare ground fell to −5°.

Weathering of the Soil under various External Influences.—Dr. Th. Dietrich.—The author examines the action of the atmosphere, of ammoniacal salts, of cultivated plants upon different soils, and upon the geological formations from whose decay the soils have originated. Among the ammoniacal salts the chloride was the most energetic, as it increased the solvent power of water twenty-five times. The sulphate of ammonia, however, rendered the greatest proportion of potash soluble.

Contributions to the Absorption-Phenomena of Arable Soils.—Prof. Eichhorn.—The author, carrying out the ideas of Way, has examined the power of certain natural hydrated double silicates in absorbing saline solutions. His main results are that the hydrous double silicates of alumina and lime—*e.g.*, chabasit and stilbite—absorb ammonia from solutions of ammonium chloride and phosphate very readily. Anhydrous double silicates not decomposed by hydrochloric acid, such as felspar, do not absorb ammonia. Silicates decomposable by hydrochloric acid, such as leucite and blast-furnace slag, take up a more considerable amount.

Use of Potassic Saline Manures, especially the Kainite of Leopoldshall.—Dr. P. Wagner.—Potash applied to the soil in the form of crude kainite is diffused more equally and further in the soil than pure salts of potash.

Yearly Requirement of Mineral Matter for an Acre of Ground Planted with Riesling Vines.—Prof. C. Neubauer.—The author gives analyses of the different parts of the vine, of the vine itself, and the lees, and from the average proportions of these deduces the amount of mineral matter to be supplied.

Cultural Experiment with Different Seeds of Sugar-Beet, with Examination of the Yield.—Professors Drechsler and Tollens.—In this experiment the "Schlieckmann" variety yielded the largest gross crop, the greatest proportion of sugar, and the smallest of other matters.

Contributions to the Knowledge of the Physical Properties of Milk.—Dr. W. Fleischmann.—The author determines the specific heat of milk.

The Albumenoid Bodies of Milk.—F. Selmi.—The author did not succeed in detecting the "lacto-protein" of Millon and Commaille, nor the albumenoid body which these chemists precipitate with the sulphate of mercury.

Properties and Preparation of Rennet.—Olof Hammersten.

Saccharomyces Cerevisiæ and Free Oxygen.—Prof. A. Meyer.—The author does not consider Brefeld's experiments sufficient to prove that respiring and germinating yeast cells are incapable of setting up alcoholic fermentation.

Production of Low Organisms in Liquids Free from Germs.—Onimus.—The author concludes that the lower cryptogamous organisms, the bacteria, arise spontaneously, and develop themselves in albumenoid liquids in the absence of air.

Justus Liebig's Annalen der Chemie,
October 6, 1875.

Dissociation of Salts containing Water.—H. Precht and K. Kraut.—The authors consider the dissociation-heat of a salt containing water to be an interval between two temperatures, the lower of which is marked by the commencement of the loss of water, and the upper is reached when the salt has become anhydrous, and the tension of the vapour it has yielded is equal to that of free steam. It is assumed that during the dehydration of a salt within the dissociation temperature a mutual reaction arises between the partially dehydrated salt and the escaped water, which prevents the further loss of water, or produces an equilibrium. For every given size of the vacuum, and for every quantity of the salt, the upper boundary of the dissociation-temperature is different; and the curve representing the mutual action varies in its form. At a given temperature, and with a limited vacuum, the tension of an aqueous salt depends upon its quantity. With the quantity the tension increases, and approaches a limit which, within the temperature of dissociation, is probably

only reached in case of an infinite quantity. If, on the other hand, the temperature and the quantity of the salt are constant, the size of the vacuum determines the attainable tension. A small vacuum determines a higher tension, a large vacuum a lower tension—a proposition which follows, indeed, from the former. The authors then describe the apparatus employed, which cannot be understood without the accompanying figures, and give the detailed results of their experiments on gypsum, sulphate of cadmium, ferrous sulphate, ammonio-ferrous sulphate, ammonia- and potash-alum, and carbonate of soda.

Substitution-Products of Citric Acid, and an Attempt at its Synthesis.—Dr. B. Pawolleck.—The author describes oxy-citrates of potash, soda, lime,—

$$(C_6H_5O_8)_2Ca_3+(OH_2)_9,$$

baryta, cadmium, copper, zinc, and ethyl. He attempted to replace the chlorine in mono-chloro-citric acid by hydrogen, but without success.

Synthesis of Sulphuretted Tannine.—Hugo Schiff.—The author considers pure tannin free from sugar as an ethereal anhydride of 2 molecules of gallic acid. He endeavoured to ascertain in how far aromatic oxysulph-acids are analogous in their behaviour to the corresponding carbon acids. During this investigation he discovered a class of sulphuretted compounds, possessing almost all the attributes of tannin. Among these are phenol-sulph-acid anhydride, tri-chlor-hydro-chinon-sulph-acid, pyro-gallol-sulph-acid, sulpho-tannic acid, sulpho-gallolic acid, pentacetyl-sulpho-tannic acid, and sulpho-acids of phloro-glucin.

On Lievrite.—L. Sipöcz.—The analyses of lievrite have been somewhat discordant, especially as regards the presence or absence of water. The author having obtained some well-crystallised specimens from Elba undertook several analyses, and found its average composition—

Silica	29·67
Ferric oxide	21·26
Ferrous oxide	33·09
Manganous oxide	0·74
Lime	13·33
Water	2·32
	100·41

Dimethyl-Parabanic Acid and Succid-Cyanic Ether.—M. Menschutkin.—In addition to the two compounds named in the title the author describes ethyl-succinuric acid and succid-cyan-methylic ether.

Amidoid Derivatives of Hydroxylamin, Cinnam-hydroxamic Acid, and Dicinnam-hydroxamic Acid.—Dr. E. Rostoski.—The author describes the preparation of these compounds, and the cinnam-hydroxamates of potash, $N(C_9H_7O)HKO+N(C_9H_7O)H_2O$, of soda, baryta, lead; the distillation of cinnam-hydroxamate of baryta; di-cinnam-hydroxamic acid, $N(C_9H_7O_2)HO$, and its potash, soda, lead, and silver salts, and its decompositions. Dr. Rostoski finds that cinnamic acid forms hydroxylamin derivatives, which have essentially the character of the known hydroxamic acids. The transformations of cinnam-hydroxamic acids are less simple than those of the other hydroxamic acids, and possibly take a different direction.

Isomeric Tri-benz-hydroxylamines.—Dr. A. Steiner.—Not suitable for abstraction.

On Opianin.—O. Hesse.—The author proves that opianin is simply pure nicotin. The distinctions found by Hinterberger may be traced to his having compared it with an impure sample of narcotin.

Chinicin and Cinchonicin.—O. Hesse.—A lengthy paper of great interest, but not fit for abstraction.

Glycogen and Glycocoll in the Muscular Tissue of Pecten Irradians.—N. H. Chittenden.

Researches on Para-Sulpho-Benzoic Acid.—Ira Remsen.—The author examines the formation of para-oxy-benzoic acid from sulpho-benzoic acid, and treats of para-sulpho-benzoic acid as an ingredient of crude sulpho-benzoic acid; the formation of para-sulpho-benzoic acid from sulpho-toluolic acid; para-sulpho-benzoic acid and its salts; nitro-para-sulpho-benzoic acid; the formation of terephthalic acid from para-sulpho-benzoic acid; attempts at the preparation of ortho-sulpho-benzoic acid; the oxidation of the amides of sulpho-toluolic acid, which yields para-sulph-amin-benzoic acid.

Communications from the University Laboratory of Halle.—These communications consist of a paper on "Triacetonamin and Certain of its Salts;" one on a "Fourth Aceton Base, Iso-triaceton-amin;" and one on "Diaceton Alcohol," all by W. Heintz.

Gas Given Off by Apples.—C. Bender.—The gas, very carefully collected, was found to consist of—

Carbonic acid	40·20
Oxygen	0·43
Nitrogen	59·37

The oxygen is probably an impurity.

Gas from the Capsules of Colutea Arborescens.—C. Bender.—The gaseous mixture consisted of—

Carbonic acid	2·2
Oxygen	18·7
Nitrogen	79·1
	100·0

Improved Balance with Aluminium Beams.—F. Frerichs.—This paper requires the accompanying illustration.

Distillation of Stilben, and on the Secondary Products then Produced.—Dr. Carl Forst.—In this paper we find a description of the action of heat on benzyl-sulphide; an account of tolallyl-sulphide; the action of heat upon barium-phenyl-acetate in presence of sulphur; and the preparation of stilben from toluol.

Aërial Checking for Analytical Balances.—Prof. Ærzberger.—A description of a very ingenious contrivance for reducing the vibration of the balance in delicate operations. The mechanism cannot be intelligibly described without the accompanying figure.

MISCELLANEOUS.

Metropolitan Gas.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently reported to the City authorities and to the Metropolitan Board of Works the results of the daily testings of the gas supplied to London by the Chartered, the Imperial, and the South Metropolitan Gas Companies during the last three months. The illuminating power, he states, has been ascertained by burning the gas at the rate of five an hour from a Sugg's London argand, in the case of the common gas, and from a bat's-wing burner in the case of cannel gas. The results at the nine testing places have been as follows:—Chartered gas: Beckton, equal to 17·88 standard sperm candles; at Friendly Place, 16·45 candles; and at Ladbroke Grove, 16·88 candles. Imperial gas: Carlyle Square, 16·92 candles; Camden Street, 16·19 candles; Graham Road, 16·87 candles; and Bruce Terrace, 16·11 candles. The South Metropolitan gas, 16·12 candles; and the cannel gas of the Chartered Company, 21·41 candles. These results show that the illuminating power of the gas has been above the requirements of the Acts of Parliament. As regards impurity, Dr. Letheby reports that the Chartered gas at Beckton contained traces of sulphuretted hydrogen on eight occasions, but at all other stations the gas was quite free from this impurity. The average proportions of sulphur in the gas were 11·32 grains per 100 cubic feet at Beckton, 8·92 grains at Friendly Place, 11·77 grains at Ladbroke Grove, 9·24 grains at Millbank, 16·13 grains at Carlyle Square, 11·73 grains at Camden Street, 7·61 grains at Graham Road, 10·48 grains at Bruce

Terrace, and 13·61 grains at Hill Street, Peckham. On one occasion at Beckton, and on two occasions at Bruce Terrace, the gas contained an excess of sulphur (over 15 grains per 100 feet); and on two occasions at Hill Street the proportions of sulphur exceeded 20 grains per 100 feet. The cause of this excess in the gas at Beckton and at Bruce Terrace, as well as the presence of sulphuretted hydrogen in the Beckton gas, has been the subject of investigation, and Dr. Letheby finds that it was due to accidental circumstances. The proportion of ammonia in the gas has never reached the prescribed amount of 2·5 grains per 100 feet, the averages at the several testing places being from 0·02 of a grain to 1·47 grains per 100 feet.

Underground Waters in the New Red Sandstone and Permian Formations of England.—At the Bristol Meeting of the British Association for the Advancement of Science Mr. C. E. De Rance, F.G.S., read an abstract of the preliminary report of the Committee appointed last year, with Professor Hull, F.R.S., as chairman, and Mr. De Rance, as Secretary, "for the purpose of investigating the underground waters in the New Red Sandstone and Permian formations of England, and the quality and character of the water supplied to various towns and districts from these formations." As regards *quantity* the report states that in the Nottingham district the Bestwood pumping station yields more than 3½ million gallons per day from the Pebble Beds, the supply of water from which, as proved by colliery operations in the Newstead area, is practically inexhaustible. The Wall-grange springs, near Leek, in Staffordshire, in the same formation, supplying the Potteries' waterworks, also yield 3 million gallons daily; and in Liverpool and in Manchester the New Red Sandstone yields more than 6 million gallons per day to the various wells of those districts. Plentiful supplies are yielded by wells in the south-west of England, reported on by Messrs. Pengelly and Moore, at Maidencombe, near Torquay Teignmouth, Tiverton, Dawlish, Bramford, Speke, near Exeter Taunton, Wellington, and Wembdon. In the Midland counties, at Leicester, Nuneaton (250,000 gallons), Coventry (well entirely in the Permian, yielding 350 gallons per minute), Hinckley, Elmsthorpe, and Hathern, where the water rose 50 feet into the air from the Lower Keuper Sandstone. Good supplies of moderately hard water are supplied by New Red wells, to Southport, Birkenhead, Ormskirk, St. Helen's, Ince, and a large number of other towns in Lancashire. The available area in England of water-bearing New Red and Permian formations is much larger than the actual outcrop of these rocks as shown on the geological maps, there being extensive tracts of Lias and other newer formations that can be easily penetrated, and a supply of water obtained as at Scarle, in Lincolnshire, where a bore-hole of 4 inches penetrated the Lias and Keuper Marls, and struck in the Lower Keuper Sandstone a feeder of water, which rose to the surface and yielded 11 gallons. Below this feeder, which occurred at 790 feet, another was struck at 950, which yielded a much larger supply. With regard to the *quality* of the waters the various analyses obtained place the New Red and Permian waters in an intermediate position between the hard waters of the mountain limestone and chalk and the soft waters of the Palæozoic rocks. In the water obtained from a well at Whitmore, near Crewe, the site of which was chosen by Professor Hull, only 6·10 grains of solid matter occur, and in another of the London and North-Western Railway wells, that of Parkside, near Warrington, only 11·12 grains of solid matter per gallon occur, the degree of hardness being 4·1 after boiling. The water is stated by Mr. Ramsbottom, the Superintendent of the Locomotive Department of that railway, to be the best for engine boilers, of all the waters obtained on the Company's system. Mr. Plant reports the Permian water of Leicestershire as soft, the water from the Bunter New Red beds as nearly soft, and those from the Keuper Sandstone as hard, containing carbonate and sulphate of lime. It is the presence of the last ingredient in the water used in brewing at Burton-on-Trent, by Messrs. Bass, Allsopp, Salt, and other firms, which is believed to give the Burton water its special pre-eminence in the manufacture of beer. Mr. Molyneux believes the large amount of calcareous ingredients here met with (70 grains in an imperial gallon) to be due to the water dissolving all the gypsum of the Keuper Marls of Needwood Forest, from whence it flows down the dip planes of the strata to the Burton-valley fault, up which it rises, and is tapped by the artesian borings of the breweries. Some of the wells close to the Mersey, at Liverpool, show examples of very hard water, and are daily becoming more so, through the percolation of salt water, induced by pumping inland; but this in no way affects the large wells used by the Corporation for water supply further from the river.

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QUARTERLY JOURNAL OF SCIENCE.

Edited by WILLIAM CROOKES, F.R.S., &c.

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CONTENTS.

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IV. The Possibility of a Future Life.
V. The Channel Tunnel.
VI. The Arctic Expedition of 1875.

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THE CHEMICAL NEWS.

VOL. XXXII. No. 833.

ANALYSIS OF GRAPHITE FROM SIBERIA.

By SERGIUS KERN, St. Petersburg.

HAVING lately analysed two samples of Siberian graphite from the Stepanovsky mine, I think the results of the analyses may be of some use. The Zeilon graphite containing 80 per cent of carbon and coming from England to Russia is far richer and cleaner, and mixed with Russian graphite is used for the manufacture of black-lead crucibles.

Analyses of Stepanovsky Graphite.

	Samples No. I. Per cent.	No. II. Per cent.
Carbon	36·06	33·20
Silica	37·72	43·20
Ferric oxide	4·02	3·05
Alumina	17·80	15·42
Lime } Magnesia }	1·20	1·06
Volatile matter	3·20	4·03
Sulphur	traces	0·04
	100·00	100·00

ON THE DECOMPOSITION OF THE TRICHLORIDES OF ANTIMONY AND BISMUTH.

By R. W. EMERSON MACIVOR, F.C.S.

WHILE preparing a hydrochloric acid solution of antimony trichloride for laboratory use, I made an interesting observation regarding its decomposition by water, which, so far as I can learn, is not noticed in chemical handbooks. If the hot, somewhat concentrated, solution of trichloride is diluted with boiling water until a faint, permanent turbidity, due to the precipitation of antimonious oxychloride, is produced, and, after the addition of a drop or two of strong hydrochloric acid to dissolve the turbidity, allowed to cool, it will become converted into an almost solid mass of amorphous oxychloride, which, on heating to about 100° C., re-dissolves, producing a perfectly clear solution, from which, on cooling, the oxychloride again separates. A quantity of the precipitate was collected, dried, digested, and thoroughly washed with carbon disulphide, and submitted to analysis, when it was found to have the following centesimal composition :—

Sb	76·19
Cl	11·32
O (as difference)	12·49
	100·00

These numbers correspond very well with those required by Sabanejeff's oxychloride, $Sb_4Cl_2O_5$ or $2SbCl_3.5Sb_2O_3$:—

Sb_4	76·37
Cl_2	11·11
O_5	12·52
	100·00

When hot concentrated hydrochloric acid is saturated with antimonious oxychloride, $Sb_4Cl_2O_5$, and the solution cooled, an oxychloride containing less chlorine than the original compound is precipitated.

When a hot concentrated solution of bismuth chloride is diluted with boiling water until a slight permanent precipitate of oxychloride is formed, and then permitted to cool down, little or no oxychloride separates.

Scientific Chemical Laboratory,
Andersonian University, Glasgow.

THE PRINCIPLES ON WHICH LEGISLATION RESPECTING THE POLLUTION OF RIVERS SHOULD BE BASED.*

By Dr. CORNELIUS FOX,
Health Officer of East, Central, and South Essex.

So much has been written and spoken relative to the great question of the pollution of rivers that the minds of legislators and scientific men must be wearied with the whole subject. That the people of this country think it a very important one, and desire earnestly that some satisfactory settlement may soon be arrived at cannot be doubted. To many it is a question fraught with danger to trade and therefore to be opposed in every shape and form. And yet every one who has ever thought on the matter would, I believe, freely acknowledge that to convert our streams into open sewers is very unwise in every sense of the word. The public have apparently ranged themselves into two classes on this question, as they do on almost every public one, those, consisting principally of manufacturers, who oppose legislation having for its object the prevention of the pollution of rivers on the ground of its interference with trade, and another class who advocate their restoration to the condition of trout streams. To permit the filthy inky watercourses of the manufacturing districts to remain in their present state is to allow a few men to afflict thousands with gigantic public nuisances. To quietly sanction the pollution of 3,000,000 gallons of river water daily by five firms, as at Bradford, and to complacently allow 75,000 tons of cinders to be annually deposited in the river Irwell is of course suicidal policy. To argue that, because manufactories which pollute streams and air give sustenance to hundreds and thousands of work-people on their banks, whose vital energies are lowered (thus rendering them a more ready prey to disease) and whose offspring are stunted and depraved by the unwholesome influences to which they are subjected; to argue, I say, that, because these great industries fill the stomachs of these people, they ought not to be required to be conducted in a manner which is not detrimental to their health, shows a want of all proper feelings of humanity. Whilst, however, condemning an extreme degree of pollution, I do not, like many, think that it would be wise to be too exacting as to purity.

Those who are acquainted with the practical working of the Sanitary Acts and are engaged in an incessant warfare with the development and spread of preventible diseases know full well that the principles on which all their work rests consists mainly in the prevention of air pollution and of water pollution. Filth in the air we breathe, and filth in the water we drink is the one great enemy in two different media against which we Health Officers are always fighting. As the question of the pollution of rivers is primarily and essentially a sanitary one, and secondarily a commercial or pecuniary one, why, I ask, should not the same principles be applied in dealing with it as with all other sanitary evils which involve exactly similar considerations. It will, I presume, be acknowledged that for legislation on this question to be possible all extremes must be avoided. To advocate the restoration of our streams to a state of purity resembling that of a mountain rivulet is to obstruct and in fact to oppose all legislation on the matter. The crippling or destruction of many industries of national value would necessarily follow such an enactment, for the expenditure incurred in purifying their waste waters would consume or most

* Abstract of a paper read at the Social Science Congress of 1875, October 13.

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seriously affect their legitimate profits. I maintain, moreover, that, if it were possible, it would be force wasted, for no adequate compensatory advantage would be gained. All who have paid attention to the very interesting topics as to the effects on health of various kinds of water agree that spring water is to be preferred to all other kinds, and tnat river water *un*polluted to any extent by sewage needs more or less of purification by filtration, &c., which is costly, before it is fit to drink. The Duke of Somerset placed the matter in its true light when he recently said in Parliament:—"The foul matters encumbering streams may be got rid of, but the notion of their supplying water fit to drink must be altogether put aside. Towns must be supplied with pure water for drinking purposes in some other way." As the prevention of the pollution of the foulest of our streams would seem to necessitate the stoppage of important industries, and the purification of such streams so as to render them adapted for drinking purposes is of course not to be thought of, let us ask ourselves the questions (1) What harm do these streams corrupted by sewage and trade products do, and (2) How are they to be prevented from inflicting injuries?

(1) WHAT HARM DO THESE STREAMS CORRUPTED BY SEWAGE AND TRADE PRODUCTS DO?

(A) *Many of them pollute the air lying over them and on their banks.* Noxious odcurs sometimes or always arise and annoy those who live near them, or those living at a distance who approach them. If human beings are exposed frequently to unpleasant smells a deleterious influence is exerted on their health. I know all that may be said in opposition to this statement. I shall be referred to the absence of any noticeable evil effects in London during the year when the Thames was so odoriferous, and to the supposed immunity from cholera and other preventible diseases of the sewer men of Paris, &c. It is a well established rule, to which there are some apparent exception, that there is a greater mortality amongst those who are exposed continually to offensive odours than with others who are not so circumstanced, and that the diseases from which the former suffer are of an asthenic type and tend to death rather than to recovery. A certain amount *vis medicatrix naturæ* is lost by them and its want is felt at critical periods of sickness when most needed. Evaporation is constantly in a greater or less degree proceeding from the surface of water, and organic impurities contained in the water, if excessive, are mechanically conveyed into the air during this process of vaporisation. The odours of many of these rivers, like those of foul ponds, are generally noticed more at sunrise and sunset than at other periods of the twenty-four hours, in consequence of the descending dew preventing their diffusion and rendering the impurities soluble and thus more perceptible to the sense of smell. My experience as a physician has taught me that it is prejudicial to health to frequently breathe air polluted by emanations from very foul water. Unpleasant smells are danger signals, and although it is absurd to fear an attack of illness whenever we have our olfactory nerves offended, yet there can be no hesitation in saying that the continual exposure of the human frame to polluted air tends to engender ill-health even if it does not create disease. The contamination of the air by many of these streams is as great a nuisance (taking this word in both its literal and legal or popular sense) as the pollution of the air by volumes of smoke which is, subject to some saving provisions, an actionable offence.

(B) *Many of them destroy fish.* Certain kinds of fish, such as the trout, require, in order to live, water of great purity. Others, such as chub, dace, roach, jack, barbel, perch, pike, eels, &c., flourish in water which would be considered comparatively dirty, whilst no fish whatever will, I believe, live in some of the most impure streams, and in those poisoned by the metallic waste of mines. In rendering streams so foul or poisonous that no fish can exist in them certain manufacturers and miners damage one of our food resources, by rendering an important article of diet scarce and dear, and therefore not to be procured by the poor man, and by lessening the self reliant powers of the country.

(C) *Silting up of watercourses and obstruction to navigation.* The quantities of solid impurities thrown into some streams are so great as to fill up their beds, thus creating inundations of their banks higher up. These solid matters produce a silting up of rivers, and an obstruction to navigation by the accumulation of offensive banks of mud. On public grounds these evils should be rendered impossible.

(2). HOW ARE THE STREAMS TO BE PREVENTED FROM INFLICTING INJURIES?

The injuries being the pollution of the air (for no one ever thinks of drinking such water) the destruction of all kinds of fish, or an obstruction to navigation, and to the escape of surplus waters during flood, my answer is simply and solely the following:—Let our scientific chemists ascertain the point at which a stream begins to be so impure as to contaminate the air lying over it, and here let a line be drawn. Let them ascertain the point at which a water becomes so impure as to prevent life and multiplication of the less particular of the finny tribe, and here let another line be drawn. Let them ascertain the amount of suspended impurities a stream may contain without depositing in its course sufficient to offer at some future time an obstruction to the ready escape of flood-waters and to navigation, and here draw a third line. Whether these lines would coincide or not, I do not know. Probably not. The nature, as well as the quantity of the impurity, would have to be considered in a question of this sort, the rapidity of the stream, and many other matters. Standards of some kind we must have, as well for the protection of the innocent as for the ready conviction of the guilty. To attempt legislation without any definite rules for guidance would be to court a failure. I maintain, then, that, instead of establishing such impracticable standards as were recommended by the Rivers Pollution Commission, we should adopt three simple standards of the kind just indicated. No stream should corrupt the air lying over it or on its banks, under any conditions of air pressure, temperature or humidity, or level of its waters, for, if it does, it is detrimental to the health of those living near it. No amount of impurity in a river should be tolerated which would injure one of the food supplies of the people, to wit, the less dainty feeders amongst our river fish. No stream should contain so much suspended impurities as would tend to its obstruction in time of flood and to the silting up of the mouths of navigable rivers. As for the practice in some parts of shunting large quantities of cinders, ashes, and solid refuse into streams in order to avoid the expense of carting them away, and of placing solid matters on the banks of rivers, so that they may be washed into them in times of flood, such proceedings should be rigorously prohibited by law as being injurious to public interests.

As regards the pollution of *tidal* rivers, the law, as it at present stands, is not in accordance with the spirit of the rest of sanitary legislation. It is illegal to pass any filth into a tidal river according to the Public Health Act of 1875. If filth is passed into a river, and any one can show that he is injured thereby, the Health Authority of the district is liable to an action at law. Some rivers are guarded by conservators or water bailiffs, whilst others are not so cared for. How are the silting up of the banks of tidal rivers, and the accumulation of filth interfering with navigation, to be prevented in the case of rivers not fortunate enough to be possessed of guardians? It is of no use to forbid a thing whilst unpossessed of any power to prevent that which is forbidden from being effected.

To establish three simple standards of the kind which I have suggested is to extend the sound principles of sanitary law, the burden of which is that you shall do nothing which is injurious to the health of your neighbour or to the public welfare.

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REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 219.)

On the evidence of these documents the procedures for illumination with hydrogen hitherto employed must be condemned if anything further is desired than the display of objects and transparencies for the lecture-room or the stage.

Hydrogen lighting was not represented at the Vienna Exhibition—a further indirect evidence that it had not found any wider application.

An objection, long known, depends on the high co-efficient of diffusion of hydrogen, and its consequent ready escape through the pores and fine chinks of the mains, a circumstance the more dangerous, as hydrogen is not, like coal-gas, at once detected by its odour. The diffusion-coefficients of gases, according to Graham's experiments, are inversely as the square roots of their specific gravities.

But if lightness is a disadvantage for the delivery of hydrogen through pipes, we have now to consider the advantages springing from the same attribute. In November, 1872, a dream long cherished seemed on the point of fulfilment. The Brothers Etienne and Joseph Montgolfier sent up the first balloon at Avignon by means of hot air.†

With natural enthusiasm the populace of Annonay applauded them when, on June 4, they repeated the experiment of the previous year on a larger scale, and king, court, and capital congratulated the inventors when they repeated it soon afterwards at Versailles. The dominion of the air seemed won for mankind, to whom space had now no limits. To day we look back upon the invention with a cooler glance, as, in spite of the lapse of ninety years, it has remained in its infancy. We are still unable to speak of aërial navigation, since the balloon, incapable of being steered, has remained the plaything of the air instead of becoming its ruler. One step, indeed, towards the desired end was taken when Charles, Professor of Physics at the Conservatoire des Arts et Métiers, at Paris, substituted hydrogen for the heated air in the balloon. On August 27, 1783, Charles, in concert with the Brothers Robert, skilful mechanicians, accomplished the ascent of the first hydrogen balloon in the Champs-Elysées, his invention being known as the Charlière in contradistinction to the Montgolfière. Both systems were used for the first aërial voyage, the one in November and the other in December of the same year. Previously the balloons had been sent up empty, or only tenanted by some animal. The first aërial navigator, Pilâtre de Rozières, conceived the idea of combining both systems, which was the occasion of his death. The fire in the Mongolfière was communicated to the hydrogen in the Charlière, and on June 15, 1785, balloon and aëronaut fell shattered on the limestone rocks of the coast, near Boulogne.

The motive for this unfortunate combination was the wish to raise or lower the balloon by stirring up or extinguishing the fire—a plan which makes ballast superfluous, and which has been revived in a recent essay‡ by Captain Gaede (of the Military School at Hanover), and with due precautions would be doubtless practicable. Since the time of Pilâtre de Rozières 3700 balloon ascents have been undertaken, and only sixteen fatal accidents have been heard of,‖ due chiefly to montgolfières, though the sea has been repeatedly crossed by aëronauts. Not long after the discovery of balloons they were used both for practical and for scientific purposes. Coutelle used them for military reconnoitreing, and according to Carnot's testimony, contributed essentially to the result of the battle of Fleurus. On the other hand, Captain Gaede considers the results attained by means of balloons, especially in reconnoitreing fortified places, both in earlier campaigns and in the Franco-Prussian war of 1870-71, as insignificant. Napoleon I. regarded the military efficiency of the balloons of his time not more favourably. After his return from Egypt—where the attempt to convince the natives of the superiority of Europeans by means of a balloon ascent had failed, owing to their fatalistic indolence—he closed the military-aërostatic school which had been founded at Meudon under the management of Coutelle and Conti, evidently holding its military results as unimportant.

(To be continued)

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† The historical details concerning aëronautics, where no other authorities are given, are taken from the excellent summary of Louis Figuier in *Merveilles de la Science*, ii., 426-626. See also Marion, "Les Ballons," Paris, 1867; and Fonvielle, "La Science en Ballon," Paris, 1869.

‡ Gaede, "Ueber den Bau Gefesselter und Lenkbarer Luftschiffe." Berlin: Mittler, 1873.

‖ Stephan, "Weltpost und Luftschiffahrt. Berlin: 1874.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 4, 1875.

Professor Abel, F.R.S., President, in the Chair.

After the names of the visitors had been announced, and the minutes of the previous meeting read and confirmed, Messrs. O. C. Mackenzie, Thomas Purdie, and W. S. Carpenter were formally admitted Fellows of the Society. The names read for the first time were those of Messrs. W. S. Curphey, E. A. Sturman, M.A., J. Kersham, G. W. Rawlins, A. Boak, R. L. Barnes, W. E. Halse, T. H. Dodd, E. Payne, R. Harvey, J. F. M. H. Stone, E. H. Girling, J. Monckman, T. McKean, A. Taylor, T. H. Bland, S. Wills, E. H. Cook, A. St. Clair Buxton, J. C. Oman, J. C. Thresh, A. W. Postans, P. R. Ogle, F. C. Desvignes, F. M. Jennings, and S. A. Prus Szczepanowski. For the third time—Messrs. Alfred William Gerrard, James Brett Guyer, Ernest Gee, and Alfred Newton Gow, who were balloted for and duly elected.

The first paper was by Mr. G. Johnston, "*On the Decomposition of Stearic Acid by Distillation under Pressure.*" Although solid paraffin is not altered by being heated to its boiling-point in a sealed tube, Thorpe and Young have shown that, when repeatedly distilled under pressure, it is resolved into liquid hydrocarbons. Now Berthelot found that stearic acid was scarcely altered by being heated in a sealed tube to 300°, or by simple distillation; it seemed probable, however, that a different result might be obtained if it was distilled under pressure. On making the experiment, this was found to be the case; oily compounds are formed, together with water and carbon-dioxide. An examination of the product showed that it consisted chiefly of a mixture of paraffins and olefines, with a small amount of ketones. The author believes the stearic acid to become dissociated at a high temperature, and the products, being quickly cooled in the condenser, are removed from the sphere of action before they have time to re-unite.

Mr. David Howard said a very interesting point presented itself with reference to this dissociation of stearic acid, and that was the reversal of the process so as to form again the acid from the products obtained. If this could be done, it would throw much light on the constitution of the body.

The President having thanked the author,

Dr. C. R. A. Wright read a paper "*On Isomeric Terpenes and their Derivatives*" (Part V.), by himself and G. H. Beckett. The paper contains an account of the peppermint camphors from Japan. The solid camphor consists of an alcohol, $C_{10}H_{19}.OH$, which splits up, by the action of dehydrating agents, into water and the hydro-

carbon menthene, $C_{10}H_{18}$; this unites with 4 equivalents of bromine, forming a compound $C_{10}H_{18}Br_4$, which, when cohobated for a few hours until hydrobromic acid ceases to be evolved, and then distilled over sodium, yields nearly pure cymene. By oxidation with chromic mixture this gives acetic acid and terephthalic acid, and with nitric acid paratoluic acid. It is identical, therefore, with the cymene obtained from other essential oils. The liquid camphor appears to consist of a solution of the solid camphor in a liquid of the composition $C_{10}H_{18}O$. The authors also treated the hydrocarbon, $C_{15}H_{24}$, obtained from oil of cloves, with bromine, in the proportion indicated by the equation—

$$2C_{15}H_{24}+3Br_2=3C_{10}H_{14}+6HBr.$$

A heavy oil was obtained which, on being heated, evolved hydrobromic acid, but no cymene could be isolated from the product, a hydrocarbon of the composition $C_{15}H_{22}$ being produced. They also examined the liquid which drops from the mass of camphor during the process of sublimation. It seems to be a complex mixture probably containing a hydrocarbon of the terpene series, a body of the composition of the hydrate of a terpene, $C_{10}H_{18}O$, and a liquid oil containing less hydrogen than camphor, together with much ordinary camphor.

Dr. Gladstone said he felt much gratified with the results obtained by the authors. The whole series of these terpenes was of especial interest, and the authors had materially added to their knowledge of the differences, both physical and chemical, which existed between the C_{10} and the C_{15} groups.

Mr. Kingzett remarked that Professor Church had obtained the $C_{15}H_{24}$ by continued digestion with sodium. Now, as all the C_{10} hydrocarbon group gave peroxide of hydrogen when exposed to moist air, and as the hydrocarbon $C_{15}H_{24}$ does not give it, whilst oil of cloves itself does, it was possible that the former might be produced by the polymerisation of a $C_{10}H_{16}$ compound.

Dr. Wright said it was not impossible that the oxidised constituent of clove oil, eugenol, which is a benzine derivative, might give rise to the hydrogen peroxide.

Dr. Armstrong observed that the evidence of the existence of a $C_{15}H_{24}$ hydrocarbon in the natural oils was placed beyond all doubt by the researches of Dr. Gladstone. These compounds were higher homologues of benzene, probably tripropylated benzenes.

Dr. Wright then read a second paper, by himself and Mr. Beckett, "*On the Alkaloids contained in the Aconites*" (Part I.). The material for this investigation was furnished by Mr. T. B. Groves, who prepared it in the manner described in the "Year-Book of Pharmacy," 1873 and 1874. The authors describe several bases which they have isolated from this mixture, one of which, having the composition $C_{31}H_{45}NO_{10}$, appears to be comparatively inert, whilst another, of the composition $C_{33}H_{45}NO_4$, has a powerful physiological action. A pseudaconitine, $C_{36}H_{49}NO_{11}$, which forms indistinctly crystalline masses, was also obtained. The authors consider that either the roots of the aconites contain several alkaloids capable of crystallising or of giving crystalline salts, or else that the alkaloid originally present is readily alterable and gives rise to numerous altered products during the processes of extraction and purification.

The President, in thanking the authors, said he was happy to see that they had taken up another subject which seemed likely to be fruitful in interesting results.

Mr. F. J. M. Page then gave an account of "*A simple form of Gas Regulator for maintaining a Constant Temperature in Air-Baths, Water-Baths, Incubators, &c.*" This apparatus, which is difficult to describe without a woodcut, consists essentially of a large mercurial thermometer, the bulb of which is placed in the water-bath or other apparatus to be regulated; one end of a movable tube, through which the gas passes, just touching the surface of the mercury in the stem. A bye-pass is provided in the gas system which allows some gas to pass to the burner, but not sufficient to keep the apparatus at the right temperature, the extra supply required for that purpose passing through the regulator. It is somewhat similar in principle to Bunsen's regulator, but as the thermometer is mercurial, and not an air one, it is unaffected by barometric changes; moreover, the whole apparatus being of glass, is not likely to get out of order.

The President said the thanks of the Society were due to Mr. Page for the description of his gas regulator, which left but little to be desired in point of simplicity. During the past few years he had had considerable experience in the matter, and had found Scheibler's electric gas regulator act exceedingly well; but it was not so simple, and far more costly than the present one.

A paper "*On the Fluorides of Arsenic, Phosphorus, and Iodine*," by R. W. E. McIvor, was then read by the Secretary. In this preliminary notice, the author states that arsenic trifluoride, AsF_3, may be readily obtained by distilling a mixture of arsenic trichloride, calcium fluoride, and sulphuric acid; also from arsenic tribromide and ammonium fluoride. It is a strongly-fuming, colourless liquid, which, when dry, does not act on glass. When arsenic fluoride is added to phosphorus tribromide or chloride, heat is evolved and phosphorus trifluoride formed. It boils at about 60°. Iodine pentafluoride is formed by the action of iodine on argentic fluoride; it is a volatile, colourless liquid, which does not solidify at −20°; it fumes in the air, and is decomposed with violence by water. Ethyl and methyl fluorides are gases at the ordinary temperature.

Dr. Armstrong, after stating that Professor Thorpe had been working on this subject for some time, and had already given some account of his results at the meeting of the British Association at Bristol, gave extracts from a letter he had received. Mr. Thorpe had found, on adding arsenic trifluoride to phosphorus trichloride, that the liquids do not even mix; but, on gently heating, gas is evolved, and the residue consists of arsenic trichloride. If phosphorus pentachloride be substituted for the trichloride, the action is very energetic and proceeds quite regularly, according to the equation—

$$3PCl_5+5AsF_3=3PF_3+5AsCl_3.$$

The phosphorus pentafluoride is a gas which fumes strongly in contact with moist air, and is instantly decomposed by water, with production of *phosphoric acid* and hydrofluoric acid. The vapour density determination of the gas agrees well with the theoretical number 63.

Another paper by Mr. McIvor, "*On the Iodides of Antimony*," was then read. He prepares the iodide by adding the requisite quantity of antimony to iodine contained in a suitable vessel, applying a gentle heat at first. It melts at 164·4, and boils and sublimes at a higher temperature. The author could not obtain a penta-iodide of antimony by the action of iodine on antimony.

The last paper was "*On Tolyl-Phenyl, a new hydrocarbon*," by T. Carnelly. This hydrocarbon, which is the (1·4) modification of phenyl-methyl-benzene, C_6H_5,C_6H_4,CH_3, was prepared in the usual way by the action of sodium on a mixture of bromo-benzene and pure (1·4) bromo-toluene diluted with ether. The product was then submitted to a series of fractional distillations: the yield, however, was but small—only 9 per cent. Tolyl-phenyl is a colourless liquid boiling at 263° to 267°, which, when oxidised with nitric acid, yields diphenyl-carbonic acid, $C_6H_5.C_6H_4.COOH$. It melts at 217°, and in all other points resembles the acid obtained by Schultz and by Doebner. The author has also obtained various substitution compounds from the hydrocarbon, including two isomeric mono-nitro-derivatives and the corresponding amido-compounds, also a dinitro-tolyl-phenyl.

After returning thanks to the author for his interesting communication, the President adjourned the meeting until Thursday, November 18th, when the following papers will be read:—(1) "Ethyl-Phenyl-Acetylene," by T. M. Morgan; (2) "On the Presence of Liquid Carbon-Dioxide in Quartz Cavities," by W. N. Hartley; (3) Addendum to the Paper entitled "Monthly Analytical Examination of

the Harrogate Spas, 1872," by R. H. Davis; (4) "On certain Bismuth Compounds," by M. M. P. Muir; (5) "On the Formation of Cinnamic and other analogous Acids," by W. H. Perkin; (6 and 7) "On the Action of Potassic Sulphite on the Haloid Derivatives of Phenol" and a "Note on the Action of Nitric Acid on Tribromo-Phenol," both by H. E. Armstrong; (8) "On Narcotine, Cotarnine, and Hydrocotarnine," by G. A. Beckett and C. R. A. Wright; and (9) "The Decomposition of Alcohol and its Homologues by the Joint Action of Aluminium and its Halogen Compounds," by J. H. Gladstone and A. Tribe.

SCHOOL OF PHARMACY STUDENTS' ASSOCIATION.

THE above Association held its first meeting for the session of 1875-76 at 17, Bloomsbury Square, on Thursday evening, October 21, Professor ATTFIELD, President, in the chair. There were present between thirty and forty members and some visitors.

The Secretary reported that during the last session the number of members had been fifty-eight, and there had been fourteen meetings. The first was held on January 21, when Professor Attfield, who had consented to become the permanent president, gave an introductory address, in the course of which he explained the educational aims of the Association, and sketched out the mode of accomplishing its object by members reading and discussing essays or papers on subjects connected with pharmacy and the sciences on which pharmacy was based. At the subsequent meetings the following papers were read:—"On Catalysis," by Mr. Chas. Shapley; "Antimony and its Compounds," by Mr. Arthur Hunt; "Pharmaceutical Ethics," by Mr. J. M. Broad; "The Analysis of Urine and its Physiological and Pathological Significance," by Dr. Senier; "Fermentation," by Mr. Chas. R. Riley; "French Pharmacy," by M. E. De Franciosi; "The Life of Count Rumford," by Mr. Harold Senier; "An International Pharmacopœia," by Mr. J. M. Broad; "Diet as a Therapeutic Agent," by Mr. Chas. J. Boorne; "The Correlation of the Physical Forces," by Mr. W. H. A. Naylor. These papers, the Secretary reported, were being transcribed into a book for circulation among the members.

The President then spoke of the pleasure felt by members of the council of the Pharmaceutical Society, and by the Professors of the School, in the continued prosperity of the Association, welcomed the old and new members of the Association and the visitors, and addressed those present "On the Best Means of acquiring Education as distinguished from Knowledge." By knowledge, he said, he meant that which they directly learned at school, in the shop, and as students, that in which they could be examined. By education, he meant, as he had elsewhere stated, enlightenment of the understanding, mental training and discipline, and general elevation of the intellect. By knowledge they could obtain a licence to practise their calling; education would enable them to practise it with success, and with real pleasure to themselves. By knowledge they would get through life; by education they would pass life happily and nobly. Let them not think that a certificate given by their examiners was a guarantee of education—it was only a guarantee of their possession, at the time, of more or less information in certain branches of knowledge. Examination called forth knowledge necessarily, not necessarily education. For the good of pharmacy and all pharmacists, he hoped the day would soon come when the Pharmaceutical Board of Examiners would be able to set their seal, not only to knowledge, but to a compulsory curriculum of study specially designed to promote education. Meanwhile students must for themselves seize all opportunities for education. The best method of acquiring education was to cultivate their powers of observation, perception, and description. From statesman to shopman, the successful men were first those whose eyes and ears were trained to receive correct impressions, or, in other words, those who were trained to observe accurately. Next, they were those who could best see through men and their motives, as well as nature and her forces; in other words, those trained to perceive intelligently. Thirdly, they were those who could best describe what they had observed and perceived. Let any member of the Association observe carefully the work of a Faraday or a Linnæus, let him endeavour to perceive the aims of such men or the working of the laws they unveiled, and then come to the fortnightly meetings prepared to describe what observation and perception had taught him, and he would help to educate his fellow-members and most certainly would educate himself. And other subjects, such as those discussed during the past year, would equally well serve the purpose. Beyond all personal advantage, also, pharmacists were bound to promote their well-being as a brotherhood and the well-being of the calling in which they were engaged. Councillors, teachers, examiners, and other representative men would be required, to fill positions which could be only worthily occupied by the well-informed and well-educated. Every member of the Association should do his best to promote its stated objects; the result would be that each would become a better man and a better member of Society.

A Committee was then appointed to examine the voting-papers, and this being done, the following were announced officers:—Vice-Presidents: Mr. Arthur Hunt and Mr. W. A. H. Naylor; Committee: Mr. Harold Senier, Mr. John L. West, Mr. Thomas Slater, jun., and Mr. Henry G. Greenish; Secretary and Treasurer, Dr. Senier, F.C.S., 17, Bloomsbury Square, W.C. A vote of thanks having been given to the President, the Association adjourned.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, April 6th, 1875.

EDWARD SCHUNCK, PH.D., F.R.S., &c., President, in the Chair.

MR. J. S. Kipping and Mr. W. A. Cunningham were appointed Auditors of the Treasurer's accounts.

"*A Study of Peat*;" Part I. By R. ANGUS SMITH, Ph.D., F.R.S., &c., V.P.

The author referred to a former paper, in which he stated his belief that calculations as to the age of peat bogs were frequently much exaggerated, and that the more highly combustible bodies called hydrogen and richer hydrogen compounds increased in proportion to age, not by addition to their substance, but by the oxidation of the other parts, and removal of carbonaceous bodies in the brown water.

After referring to the observation of oil from peat and treatment of the subject and its relation to questions connected with coal, by E. W. Binney, F.R.S., he now wished to bring forward certain scientific and certain economic points. Of the former: 1st. The rapid growth of peat, shown partly by collected experience and by numerous quotations. 2nd. The existence of the resins and bodies having a high amount of hydrogen and carbon in new as well as old peats. 3rd. The cause of the rather greater amount in the old, not from formation during decay of the plant, but their greater permanence and insolubility. 4th. The existence of similar bodies in the fresh mosses which form the peat. 5th. The possible removal of all woody fibre by decomposition, leaving only oils and resinous or similar bodies undergoing little if any chemical change. 6th. The reason, viz., that woody fibre produced no highly combustible liquids or solids during its decomposition. 7th. Suggesting that the same idea might be transferred to coal without confining it to any portion of the plant. 8th. The rapid formation of

hard peat promoted by the growth of fine mosses, which break down readily into fine powder, whereas strong stems remain long.

Next, certain economic and sanitary points. 1st. The importance of keeping up in certain parts of the country a sufficient amount of peat for the fuel of the neighbourhood. 2nd. The possibility, by proper peat culture, of increasing the growth manifold. 3rd. The question of the removal of the resinous, &c., bodies by solution instead of distillation. 4th. The value of peat as a reservoir of water. 5th. Its value as a rapid grower, if properly cultivated, for filling up wet ground and swamps. 6th. Its subsequent use in removing swamp fever, which was never found, at least in the northern peat bogs, and he believed never in the true peat bog, the cold not being the cause of this.

On recent enquiry, he had found peat which, on good evidence, had grown 30 inches in 44 years, and observers with still better opportunities gave amounts much higher, equal to 88 inches in a similar time. Taking the lower estimate, it seemed clear that Sprengel's statement was correct, that peat grew more combustible matter in an acre than forest trees grew. The specimen in question, from Deeside, on a spur of the Grampians, had a considerable density, viz., 0·92, measuring externally, or a cubic foot weighed 57 lbs., whereas a cubic foot of water weighs 62·32. The probably very cold peat of a coaly fracture spoken of by several persons is not here alluded to, and did not come under the author's observation. The amount of the wet material that grew in an acre was 2454 cubic feet in a year, and of the dry material, taking the lowest estimate of 1-6th, 10·2 tons, say 10. The estimated amount for wood in the plains below was considered to be 2½ tons per acre per annum, and this may be high, as Liebig gives only half this amount, and hay and straw, which he considered able to produce the same amount of dry material, do not produce more. The value of the peat and the wood as combustibles would differ little. The value of the 10 tons may be considered as equal to 4 tons of coal. These 4 tons, then, were grown on land which could scarcely be said to have agricultural value. Of course all bogs are not always growing at this rate, and there is a limit in time to their increase; on the other hand, by care and proper feeding, we may be able to grow the material much faster than ever it has grown, and the black bogs may become for us rich coal fields, oil wells, and whale fisheries. The fuel is not important for those places where coal is cheap, but there are many places in Great Britain where coal is difficult of transport. Since peat will not bear much carriage, its value is limited in distance, and in many places now without any it would be well to grow along with oat and potato fields a field also of this despised fuel. This is actually done, but it is rarely systematic, and in many places peat is driven out where a portion of land otherwise almost useless might be set aside for it. The systematic fostering of peat so as to increase the produce is advocated for many places, although this may appear absurd in the eyes of those who are desirous of removing entirely all its traces.

The peat which had grown rapidly was fine in texture and became heavy on drying; not of the heaviest kind, as 0·92 is high but not of the highest class. (The lightest peat examined was 0·2). The first had grown from fine or small mosses, *hypnum* chiefly, and the fineness of the fibre was apparently the cause of the rapid breaking up. It is not time alone then that is always required to make fine dense peat. Large pieces of wood may endure and be preserved long. Henceforth a new classification of peats is necessary, and this is according to the prevailing plant. To grow good peat all plants with thick stems must be avoided as giving too much woody fibre, rendering the structure too open and the peat too light, as well as giving an inferior amount (in the case of some woods at least) of the resinous and very inflammable bodies, and generally taking too long to form. The great peculiarity of good peat is the oleaginous and resinous matter, to which also wax and fats may be added, as they have been found by some. It has been generally believed that these bodies have been produced during the decomposition of the plant, although one writer, quoted in the paper, considers they were produced by the growing plant. Dr. Smith came to the conclusion that woody fibre could not be shown to produce substances rich in hydrogen, the compounds resulting from its decay were rather of a humous character and not good combustibles. If woody fibre did not leave its hydrogen and carbon in such quantity as to form the resins, &c., of peat, then we must look for the origin in the growing plant. The mosses from which the peat from Deeside was evidently grown were examined, and on drying gave about a fourth of dry matter which readily crumbled into a powder and which contained 1·27 per cent of substances soluble in a light naphtha. It much resembled that obtained from the peat, but was softer, being about the consistence of butter and capable of being distilled so as to give a yellowish substance of the same consistence. Besides this there was 1 per cent of a substance extracted by alcohol, resinous in appearance, fusible, and containing apparently the chlorophyll.

The author believed that these bodies produced the similar matter in the peat, or rather were the matter itself with little or no change. In the peat it had been hardened, perhaps by oxidation or perhaps by the removal of the more fluid portion by water. In this way he explained the possibility of having a flow of oil from a peat moss. When the substances in the plants themselves were of a more fluid character, the removal of the woody fibre and absorbing humous bodies would set them free, and the fusibility or otherwise of the substances at ordinary temperatures would depend on the plants. The oil formed by distilling the resinous bodies obtained from the peat was of a light yellow. Its true character has not been fully determined, but the analysis gave—Carbon, 83·86 per cent; hydrogen, 12·70.

The author inclined to believe that there is a great variety of oils and solid hydrocarbonaceous bodies, if not true hydrocarbons, in the plants, which so far as he knew had not been examined. The resins of the peat had been carefully examined by Mulder.

The author had not found any of the coaly peat spoken of by some authors. It might readily be supposed that when the woody fibre was removed various compounds insoluble in water would remain and account for fossil resins, ozokerit, &c. A similar action might produce coal, although the plants forming peat and coal were different and most probably the climate, and the idea of Prof. Morris (see Prof. Huxley and Prof. Dawkins on coal) that the bituminous part of coal was composed of spores and sporangia primitively supplied with resinous or oleaginous matter would so far agree with the above reasoning, although in forming peat we cannot confine ourselves to the spores, so far as the author knew at least, when wood is present having resin dispersed in it. Perhaps the same may be said of coal.

The author spoke of the great value of peat as a water reservoir in a country demanding so much water, which did not always require to be bright, and of the possibility in many positions of clearing it as it was leaving the mosses. Water reservoirs could thus be grown at a cheap rate in many spots, instead of being banked in or dug at a great expense, although growing might require perhaps more time. A reservoir formed of peat 10 feet thick would hold as much as a water reservoir of the usual kind 8 feet deep, or say 7½, and still be easily walked over.

The capacity of growing possessed by peat was so great, if the results found can be readily attained in many places, that in suitable situations it might be used for filling up swamps and making dry surfaces, for after rising to a certain height the top easily drained and left a part dry.

Swamps were sources of fever and ague. True peat bogs never were, so far as the author knew, and probably the growing of peat would render many places healthy

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which could not otherwise easily be made so. Gases from peat mosses it is intended to examine more fully, and also many peat-forming plants.

SOCIETY OF PUBLIC ANALYSTS.

ON TEA.*

By G. W. WIGNER.

(Concluded from page 190.)

The total weight of the ash of tea extract and the ash of exhausted leaves is almost invariably in excess—and sometimes very greatly so—of the ash of the tea itself, the increased weight being in some cases as much as 1·5 per cent. It is not easy to find any definite reason for this increase, which, however, appears to be mainly due to the fact that the ash of exhausted leaves and of tea extract contain together a larger proportion of carbonic acid than does the ash of tea.

Pulverised tea appears, however, to show a larger increase than whole leaf, and those samples which have been repeatedly boiled a larger increase than those which have been only boiled once in a 1 per cent solution.

The percentage of tannin in tea is very variable, and there is little doubt that this is, in a great degree, the cause of the erroneous estimate which English tea drinkers frequently make of the dietetic value of tea. They prefer tea which gives a dark coloured infusion, and has some sensible astringency, to those varieties which give a paler and a less bitter liquor. This probably accounts, to some extent, for the high estimation in which some kinds of Assam are held for mixing purposes. The acetate of lead process seems more reliable for determining the percentage of tannin than the old gelatine process, and it is certainly easier. I have therefore adopted it. I find that a sample taken from a mixture of six samples of Assam tea gave 45·5 per cent of tannin, while some of the highest results were—

	Per Cent.
No. 82. Moyune young Hyson	39·0
No. 83. Very choice Assam	33·0
No. 1. Indian young Hyson	39·0
No. 97. Assam tea from Dr. McNamara's garden	27·7
No. 75. Caper (mixed)..	42·3

It is clear, therefore, that some teas exceed the average so greatly that, as regards adulteration or impurity, the tannin determinations can give only negative results. Sometimes, however, useful confirmatory evidence may be obtained from them: for instance, a sample of tea, originally of good quality, which had been sunk in a vessel for sixteen days, gave only 3·74 per cent of tannin, a figure closely approaching that which is yielded by ordinary exhausted tea-leaves (3·80 per cent).

The high percentage of nitrogen present in tea-leaves has been pointed out by Peligot and Wanklyn. This is, of course, partly due to the proportion of theine present (theine itself containing 28·87 per cent of nitrogen). The real commercial value of tea appears to depend to a considerable extent on its proportion of theine; and if the quantity were capable of more speedy and accurate determination it would be of much value. By the present processes it is, however, difficult, or even impossible, to get a trustworthy result. Zöller's figures, for instance, are about ten times as high as Mulder's.

I have made some few determinations of the total nitrogen in tea, with the following results:—

	Per Cent.
Sample taken from 60 green teas, slightly faced	3·76
" " 60 black teas	3·26
" " 6 Assam teas	3·64
" " 6 Caper teas	3·32
" " Assam tea from Dr. McNamara's garden ..	3·88
" " Sample of exhausted leaves	3·80

* Read at a meeting of the Society of Public Analysts at the Museum and Library, Bristol, August 26, 1875.

I now proceed to consider the question of adulterated tea, premising that—as the result of the examination of hundreds of samples obtained in various ways, some from original chests, and some from retailers—I do not believe that any adulteration of tea is practised in this country. Years ago no doubt tea was occasionally faced here, and from samples which I have seen I should think very badly faced, *i.e.*, a large quantity of colouring matter was put on in such a clumsy way as to completely spoil the appearance of the leaf.

It is not uncommon for tea to be de-faced in this country, *i.e.*, to have the colouring matter either removed or so altered in appearance as to be rendered almost invisible.

As regards exhausted leaves, foreign leaves, and siliceous matter, I do not think that any Englishman could introduce them into tea so as to deceive the eye of a tea buyer, except at a cost which would render the operation unremunerative.

The Chinese have, however, special facilities for such operations during the process of "tea making," and years ago the introduction of exhausted leaves and sandy matter into low-grade Canton Capers and Ping Suey Gunpowders was by no means uncommon.

As far as I can judge, the high class teas have always been kept scrupulously free from such admixture, and this renders it even more certain that the presence of 4, 8, 9, and even 37 per cent of sandy matter (and I have found all these percentages in low class teas) must have been due to design, not accident.

Such tea seems, however, to have almost entirely disappeared from the English market during the last few years, and the inferior teas which are to be met with now are either the remainder of some old stock, or some chests which have been recovered from wrecked vessels and re-dried.

In the latter case the fact is generally evident from the tea containing a heavy percentage of common salt. Such teas are seldom offered here except for export, but the five following are illustrations:—

	Total Ash.	Ash Soluble in Aqua.	Ash Soluble in Acid.	Silica.	Alkali Calculated as Potash.	Extract.	Chlorine Calculated as NaCl.
No. 84. Congou ..	8·00	4·09	3·02	0·89	0·24	20·40	3·08
No. 85. Gunpowder	13·16	4·32	7·20	1·64	1·62	23·29	1·11
No. 86. Congou ..	5·35	2·44	2·17	0·74	0·61	26·48	1·14
No. 87. Pekoe ..	8·64	2·28	3·66	2·70	0·75	41·20	0·23
No. 88. Caper ..	8·23	2·42	3·53	2·28	0·80	36·45	0·17

The first of these had been more than a fortnight under water, and was completely soaked, and then re-dried. The two latter ones had merely been slightly moistened.

Sometimes samples have evidently been wetted, and some of the value extracted, even when salt is present in minute traces only. Thus I have found—

No. 89. Hyson ..	8·53	1·13	4·76	2·64	0·70	— traces
No. 90. Congou ..	7·27	1·35	3·54	2·38	0·70	— traces

While, again, the following are samples of tea which are obviously impure, though in the same state as when imported:—

	Total Ash.	Ash Soluble in Aqua.	Ash Soluble in Acid.	Silica.	Alkali Calculated as Potash.	Extract.
No. 91. Gunpowder..	19·73	1·00	6·15	12·58	0·14	37·78
No. 92. Caper	14·44	1·95	2·47	10·02	1·03	35·45
No. 93. "	15·20	1·69	5·35	8·16	0·61	31·60
No. 94. "	15·08	1·96	5·65	7·47	0·73	35·60
No. 95. "	12·74	2·68	3·44	6·62	1·04	—
No. 96. "	14·60	2·67	5·87	6·06	1·04	—

It is clear from these figures that each of these samples is adulterated with from 6 to 12 per cent of sandy and other foreign matter. I do not, however, think they would be likely to be met with in this country now, although very

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probably some of the foreign markets could furnish corresponding samples.

If the Custom's examination of tea, which we are now promised, is properly conducted, such teas as the above would of course be condemned, and the injustice of taking the duty on an article which it is illegal to sell would be obviated. It is to be hoped, in the interests of the tea trade, that the Customs' authorities will take care that the Analysts they appoint are not only sufficiently numerous, but that their individual experience will ensure the examination of tea being satisfactorily performed.

When I commenced this paper I purposed giving the complete analysis of a number of the ashes of tea, but the work has grown upon my hands, and it may be thought that the paper is already too long. I, however, append a few partial analyses, and I may probably some day, as opportunity serves, complete them, when I shall have pleasure in laying the results before this Society.

In the ash of a mixed sample of twenty-four genuine black teas, and in another of a number of medium quality (faced) green teas, I found—

	Ash of Black Teas. Per cent.	Ash of Green Teas. Per cent.
Potash	30·92	28·42
Soda	1·68	2·08
Sulphuric acid	4·88	5·66
Carbonic acid	11·60	6·43
Silica	1·70	7·50
Percentage of total ash soluble in aqua	57·00	52·85

In another case a sample of genuine black tea was ignited to ash, and another part of the same sample exhausted by boiling, the leaves and extract being also brought to ash, and the carbonic acid and percentage of soluble ash in each determined. The results were—

	Carbonic Acid. Per cent.	Soluble in Aqua. Per cent.
Original tea ash	12·52	57·55
Ash of exhausted leaves	5·71	21·20
Ash of extract	16·72	84·15

I desire in conclusion to acknowledge the valuable assistance which I have received, in the experiments necessary to the compilation of this paper, from Mr. R. H. Harland, one of my assistants, and an Associate of this Society.

NOTICES OF BOOKS.

Sulphurets: What they are, how Concentrated, how Assayed, and how Worked. By W. Barstow, M.D. San Francisco: A. Roman and Co. London: Trübner and Co.

The title of this book is somewhat misleading. The author treats merely of such sulphurets as are used in metallurgical operations as workable ores of copper, lead, zinc, mercury, or silver, and as contain gold in a state of mechanical dissemination. With the sulphurets used as sulphur ores, and of the way of determining the amount of sulphur they contain, he does not occupy himself. Perhaps "Metallurgy of the Sulphurets" would have been a more fitting title.

After a brief account of the sulphides of the ordinary metals, Dr. Barstow gives an account of the assay of gold, silver, lead, zinc, copper, and mercury in the dry way, adding instructions for the manufacture of "a very simple balance, which the reader can easily construct for himself, and which will be accurate enough for his purpose down to the one-thousandth of a grain." "Three weights," we learn, "are all that are necessary: one of one grain, one of one-tenth of a grain, and one of one-hundredth of a grain. The standard for the first may be found at any drug store." The second weight is to be made of fine wire, and the third of very fine wire, broom-corn, or thread. We should except that an organic substance like thread, which sometimes absorbs and sometimes gives off moisture, according to the state of the atmosphere, and to which dust and dirt readily adhere, would not make a very constant and trustworthy weight.

A short chapter is devoted to wet assays, which he does not recommend, though he admits that they give more accurate results, especially in the case of rich alloys. He might have added that the Cornish assay of a copper ore, tolerably accurate for a rich ore, falls more and more widely short of the truth as the mineral is poorer, till a point is reached when the amount of copper is returned as *nil* by the dry process, though it still exists in quantities readily determinable by the wet method. Dr. Steinbeck's process for the assay of copper ores might, we think, have been usefully given.

In the next part Dr. Barstow treats of the various mechanical methods tried for concentrating the ore by separating, as far as possible, the gangue from the actually metalliferous portions of the ore. He gives the preference to the Prater concentrator, a Californian invention as improved by Hendy.

The fourth part describes the reduction of sulphuretted ores, and in the fifth follow some very brief instructions on the blowpipe assay of ores. An index would decidedly increase the utility of the book.

Chemistry: General, Medical, and Pharmaceutical. By J. Attfield, Ph.D., F.C.S. Sixth Edition. London: J. Van Voorst.

When a work has gone through six editions in eight years, and has met with general favour in England, in India, in the United States, and even on the Continent of Europe, the task of the critic is exceedingly limited. Whatever alterations have been rendered necessary by the advance of discovery since the appearance of the last edition have been carefully and judiciously made. The work has been extended by a notice of forty substances which are official in the Pharmacopœia of India, though not in that of Britain, and presents therefore the whole of the chemisiry of both Pharmacopœias.

For all the numerous class of students who are preparing for the medical or for the pharmaceutical profession, we know of no work in the language which can be compared with the one before us. To give so much, and so well-selected, and so admirably arranged matter in such brief compass is an achievement on which the author deserves our heartiest congratulation. His declaration that while "the truths of chemistry are the same for all students, the principles of the science can be as easily illustrated by or deduced from facts which have interest as from those which have little or no special interest to the class addressed" is suggestive. Among all our manuals of chemistry—so numerous and possessing so few distinctive features as almost to constitute a nuisance—have we one that offers the young technological chemist such advantages as Dt. Attfield's work provides for the tyro in pharmacy or in medicine? If not, why not? The example here set should certainly be followed.

Manuel Pratique d'Essais et de Recherches Chimiques Appliqués aux Arts et a l'Industrie. Par P. A. Bolley et E. Kopp. Traduite de l'Allemand sur la Quatrieme Edition, par Dr. L. Gautier. Fasc. 1 et 2. Paris: Savy.

We have here the first two parts of an elaborate work on chemical analysis, qualitative and quantitative, as applied to the arts and manufactures. The book begins with instructions in manipulation, abundantly illustrated with woodcuts of apparatus. Then follows a chapter on reagents, their preparation, and their use, particular attention being given to volumetric solutions.

The section on the assay of waters, for domestic and industrial purposes, can scarcely be pronounced satisfactory. For the determination of organic matter the authors rely upon the permanganate process, the untrustworthiness of which has been abundantly proved. The analysis of gases dissolved in water they perform by means of Winkler's apparatus, which is described and figured. Waters for domestic purposes, they consider, should not contain more than 20 parts of lime and magnesia in 100,000.

In the succeeding chapter the authors give directions for the quantitative and qualitative examination of simple non-metallic bodies used in the arts, pointing out their probable impurities and adulterations. It is interesting to notice, with reference to a late trial at Leeds, that our authors treat milk of sulphur and precipitated sulphur as identical, and, without any respect to English "trade-usages," class "salts of lime" among the possible impurities to be met with in the article, and not as a legitimate constituent.

In the section treating of the alkalies we have not been able to find any instructions for the assay of salt-cake and of tank-waste. The account given of the preparations of iron used in the tinctorial arts, with the impurities likely to occur, is excellent. Still we must remember that no quantitative determination of its ingredients can throw any very valuable light upon the working properties of a "nitrate"—more correctly named nitro-sulphate—of iron. Two samples may contain the same articles in the same proportions, and yet the one may, in practice, produce meagre chalky stains, whilst the other gives full solid colours. The same remark applies with no less force to some, at least, of the compounds of tin used in dyeing.

The process recommended for the assay of iron pyrites and of burnt sulphur-ores is that of Pelouze. We do not see the advantage of this method over the direct determination of the sulphuric acid formed by the oxidation of the sulphur.

For the determination of copper in ores and alloys the authors recommend the volumetric procedures of Pelouze and of Weil,—Park's method, and what we may call the Mansfeld processes, not being mentioned.

In treating of gun-cotton the authors remark that it is "sophisticated only with ordinary cotton." For the detection of this impurity they recommend to moisten the sample with a solution of iodine in iodide of potassium, and then with dilute sulphuric acid, examining the appearances presented with a lens. Common cotton is coloured blue, whilst gun-cotton takes a yellow tinge. Or small quantities of cotton may also be detected by taking advantage of the property of cotton to appear very clear and coloured if viewed by polarised light, whilst gun-cotton only reflects the light with a feeble intensity." We cannot agree with this passage. Raw cotton may occur in gun-cotton not intentionally, but from imperfect manipulation. Or it may be added, not with a fraudulent intention, but in order to reduce its "bursting power," and make it fit for use in fire-arms. It is, we think, best detected by digesting the sample with a large excess of acetic ether, in which all forms of nitro-cellulose dissolve, whilst raw cotton remains untouched. But in the examination of gun-cotton for military or engineering purposes it is of the first importance to ascertain how much of the sample is soluble in a mixture of anhydrous alcohol and ether. The soluble portion, mono- and di-nitro-cellulose, has a much lower explosive power than the insoluble (trinitro-cellulose).

The work abounds in matter of the highest importance to the technological chemist and the commercial analyst, and its value will be further enhanced if, when complete, it is provided with a good index. A treatise of this nature—extending to 1000 closely-printed pages and well supplied with illustrations, and yet offered to the public at the price of 12 francs—is a phenomenon not yet acclimatised in England.

CORRESPONDENCE.

ESTIMATION OF POTASH IN PRESENCE OF SODA BY THE BLOWPIPE.

To the Editor of the Chemical News.

SIR,—It seems advisable to append to the paper of mine you were good enough to publish (CHEM. NEWS, vol. xxxii., p. 217), on the "Pyrological Estimation of Phosphoric Acid," a few remarks on the other subject of the British Association's Report, estimated by means of the same neglected instrument.

The most difficult association with other oxides to determine potash pyrologically in, is undoubtedly that with different alkalies, especially soda. The presence of sulphates or chlorides, and of calcium or magnesium salts soluble in water, presents no difficulties whatever to the pyranalyist, the non-metallic constituents in the first adulterations being—thus rreated—extremely volatile, and the bases in the last insoluble in boric acid.

(1). A 50-m.grm. bead of *pure boric acid* is fused before the blowpipe upon a platinum wire ring of small diameter, through which a slight blast from a blowpipe, having the platinum jet taken off, blows the red-hot bead into a bubble or vesicle about seventy times its first size. (This is the process I call "vesiculation.")

(2.) This vesicle freshly made is breathed upon strongly, and the resulting pale blue film or cloud carefully noted.

(3.) The vesicle (2) is thoroughly fused up again with about 5 m.grms. of *pure sodic carbonate*, the bead again vesiculated and breathed on, and the result noted. The pale blue film can be no longer produced, but instead of it is a colourless semitransparent tarnish, like that produced on a pane of glass by the breath. The addition of more soda will take even this away, until, as in the case of a *borax* vesicle, that remains quite transparent; but there is no necessity for this, as the distinction between the film and tarnish is quite sufficient for the purpose.

(4.) Fresh boric acid up to 20 m.grms. can now be fused on this bead (3) without causing it, when vesiculated and breathed on, to show other than a semitransparent tarnish on the surface; and this vesicle is kept as a pattern.

(5.) *Another* bead is now prepared in a precisely similar manner to (3), but at this point the potassic assay (as, for instance, powdered *Apophyllite*, which contains about 5 per cent of potash) is dissolved, as far as possible, in it, before the blowpipe, and *after* this fresh boric acid added, as in (4), but, unlike that, *this* bead—when vesiculated and breathed on—shows again the *pale blue film*, and the two vesicles should be observed together near a window, both by transmitted and reflected light, when the difference is very striking.

(6.) *Quantitative* results are obtained by calculating the proportion of fresh boric acid *required* to be added, as in (5), to produce the film, compared with that similarly required, after the addition of a weighed quantity of pure potassic silicate.

(7.) The *rationale* of the process seems that a small proportion of potash interferes less with the chemical character of boric acid than soda does,—as may be also concluded from the fact that a mere trace of the latter quite *orangises* its green "flame," while a considerable quantity of potash only intensifies it. Fresh boric acid must be invariably added *after* the addition of the potash, because the soda previously added seems to form a sub-alkaline borate which would take up more boric acid if the potash added did not prevent it, so that the final bead seems a double borate of sodium and potassium, on the surface of the vesicle of which the film formed by breathing onthe *potassic* borate overpowers the fainter reaction on the *sodic* borate.

(8.) The blue film is due to *moisture*, and not to any possible combination (as I at one time thought) of potash with carbonic acid, as may be proved by holding a b[illegible]

acid vesicle alternately in the thick smoke emitted from ignited dry brown paper, and in steam.

(9.) The pyrological estimation of either soda, potash, or lithia, not in each other's presence, is a very simple and rapid affair, as about 5 per cent of either (and not less) will diffuse the black balls of *cobalt oxide* throughout a boric acid bead of 50 m.grms., causing it to appear, on cooling, transparent and *pink*; and from 18 to 20 per cent of alkali causes a similar bead to *remain blue* on cooling, while no oxide not alkaline (except, so far as I know, that of *Thorium*, of the curious reactions of which I will give you an account in another paper) is soluble in boric acid.

(10.) Chlorides (as common salt) will, if rapidly dissolved in a boric acid bead in presence of soda, and vesiculated, afford a blue film; and chlorine is also betrayed by the smell of the smoke arising from the red-hot bead; but after a few seconds of treatment in an oxidating pyrocone the chlorine is volatilised, and the normal reactions are as those above described.

(11.) The pyrological addition of a *considerable amount* of potash, especially caustic potash, to a boric acid bead, gives a similar reaction to the resulting vesicle as that of soda does, because an alkaline borate has been formed.

12. A *sodium* silicate, fused in small proportion with boric acid, seems to leave its silica to combine with that; but, *cæteris paribus*, *potassium* prefers silicic to boric acid. —I am, &c.,

W. A. Ross.

PS.—It is in contemplation to conduct these *boric acid* assays *on a large scale*, in which the platinum wire shall be as thick as an ordinary telegraph wire, the bead as big as a hen's egg, the internal ball (*e.g.*, that formed by lime) as big as a marble, &c., the blowing-machine and lamp or candle being of course proportionately large. Assays could then, with equal rapidity, be made of 1000 m.grms., or 15·5 grains of a substance.

MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

Sir,—In reply to Mr. J. Carter Bell's criticism of my paper on the "Conversion" of brown into grey sulphate of ammonia, I may state—what I did not then make sufficiently clear—that the sulphate referred to was that containing sulphocyanide not sufficient to pay for the distillation with hydrate of lime. There are considerable quantities sent into the market containing 2 to 5 per cent, and such materials can be "converted" for a very nominal cost of labour and acid, and with already existing plant—conditions which manufacturers readily appreciate. Sulphates consisting mainly of sulphocyanide are in demand now for some purpose or other, and I should certainly never advise any one to treat them by my process.

Mr. Bell's statement of facts, as illustrative of the two methods, is not remarkable for accuracy. From his figures one would suppose that by my plan an enormous outlay of acid was required which by the other was quite unnecessary. The expenditure of acid in each case is the same for the yield of ammonia, the latter only varying.—I am, &c.,

A. Esilman.

Manchester.

MANUFACTURE OF WHITE CAUSTIC SODA.

To the Editor of the Chemical News.

Sir,—"Enquirer" asks (Chem. News, vol. xxxii. p. 225) whether the lime-mud of the causticising operation is used wet or dry? It is invariably used in the moist state, just as it is taken from the filters. It has been tried more than once to dry it, but there is no advantage—on the contrary, a great disadvantage—in doing so.

"Enquirer" may take it for granted that there is a considerable saving in using the lime-mud. Unfortunately I cannot go into the subject now, as that will be treated on in my second paper on the "Manufacture of White Caustic Soda;" but let him consider well what it costs to use, and what it costs to throw away and to buy limestone to use in its place, or even what it costs to dry it in a separate operation. Furnace-men generally get one halfpenny more per ball with one-half lime-mud.

In reply to G. P., I am not surprised that he has been unable to find a method for the complete analysis of red-liquors, &c. I could find no such a one, and had to work the subject out for myself. I have been preparing a paper at spare intervals for the last year on this subject; therefore G. P. will see I cannot now describe the details of the processes. Caustic soda works are generally too much conducted under rule-of-thumb management to require such a delicate process as this: if, however, G. P. is conducting any investigation in which the process would be of service to him, if he will describe to me privately where he has failed, I will do all in my power to aid him.—I am, &c.,

George E. Davis.

St. Helens, Lancashire,
November 8, 1875.

MANUFACTURE OF WHITE CAUSTIC SODA.

To the Editor of the Chemical News.

Sir,—I should be glad if Mr. George E. Davis (the author of the paper on the "Manufacture of White Caustic Soda") would inform me how it is that in the analysis of the balls he gives there is so little sodium sulphate, while in the liquors produced there is such a very much larger quantity.

The proportion of sodium sulphate to the alkali present should not be very different in the two cases, as sulphate is not formed in the vats on lixiviation, whereas in Mr. Davis's analyses there is about nine to ten times the sulphate, in proportion to the alkali in the liquors, that there is in the balls A and B (see Chem. News, vol. xxxii., p. 176).

To be consistent with the analyses it would require every other ball made to be as bad as the C ball, the analysis of which is given alongside A and B as a warning to black-ash makers.—I am, &c.,

Black-Ash.

Bristol, November 3, 1875.

COMMERCIAL ANALYSTS.

To the Editor of the Chemical News.

Sir,—I observe that, after some delay, the "well-known firm of chemists" mentioned in the British Association Report on the Estimation of Potash and Phosphates, and branded by me, in a letter to you, for their refusal to disclose their analytical methods, has found an apologist signing himself "Xylo." I shall not stop to enquire whether "Xylo" is himself connected with that "well-known firm of chemists," nor shall I deign to bestow a word of answer to the arguments of one who cynically observes that "After all, it is not pure Science, but money-making, which is the chief object of analytical chemistry." That remark puts "Xylo" at once out of the pale of those who have a right to be heard on matters pertaining to analytical chemistry, at least in the eyes of chemists. But with reference to a scurrilous remark of "Xylo's," which tries to make the question a personal one of my own, I beg to tell him and your readers—1st. That I am not, as "Xylo" seems to assume, an "analytical chemist" in the commercial sense, as I have never made an analysis for a fee yet, and that, therefore, the question which I raised has no pecuniary interest whatever for me. 2nd. That I *have* published a good deal on analytical chemistry (as well as on many other chemical subjects), and that I have published every new analytical method of any importance upon which I have chanced to stumble during the many years of my career as a chemist.

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As you, Mr. Editor, know both my name and my scientific position, you will contradict the above if you do not consider it correct.—I am, &c.,

CHEMICUS.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 16, October 18, 1875.

Thirteenth Note on the Electro-Conductivity of Bodies of Medium Conducting Power.—M. Th. du Moncel.—The author examines the conductibility of such moist substances and bodies, reduced to a very fine state of division, as belong to the class of imperfect conductors. He calls attention to the fact that the inversion of the polarisation current, produced on rapidly electrifying a dielectric which has previously undergone an inverse electrisation, is reproduced not merely in silicates and certain metallic ores, but also in all moist bodies, animate or inanimate, and even in the majority of liquids.

Rotatory Power of Quartz in the Ultra-Violet Spectrum.—M. Croullerois.—At the Brighton meeting of the British Association, in 1872, the author communicated the result of his researches on this subject. To effect the measurement he had recourse to the procedure of Mr. Stokes, and made use of the analytical method of MM. Fizeau and Foucault; but, notwithstanding the most favourable atmospheric conditions, it was impossible for him to carry the measurement of the rotations beyond the ray O. It is true that in his experiments the normal ultra-violet spectrum and the interference-band were seen by reflection on paper saturated with the fluorescent solution, the eye intervening only in a secondary manner in the observation of the phenomenon. When M. Soret made known to the author his fluorescent eye-piece, with which the spectrum may be regarded under the conditions of direct transmission, apparently more favourable, he pointed out to him this application of his ingenious instrument. The author has noticed, in the *Comptes Rendus* of Oct. 11, a paragraph showing that this application has been successfully tried by MM. Soret and Sarazin; but these physicists have not been able to extend their observations beyond the ray N, which shows that the absorption by transmission is still more injurious than the loss of light by epipolic dispersion.

Laws which Govern the Reactions of Direct Addition.—M. V. Markovnikoff.—When to a molecule not saturated, C_nH_mX, is added another molecular system, YZ, at a low temperature, the most negative element or group, Y, combines with the least hydrogenised atom of carbon, or with that which was already in direct connection with some negative element; but, at comparatively high temperatures, it is the element Z which fixes itself upon the least hydrogenised carbon, that is to say, that, for the same substances, the reaction takes a course exactly the opposite of the former.

Case of Oxidation of Acetic Acid in the Cold, in Neutral or Feebly Alkaline Liquids, in Presence of Nitrates and Phosphates of Soda and Potash.—M. Méhay.—Having had occasion to prepare solutions containing a mixture of acetate and nitrate of potash, the author was surprised to find—after some days, during which the liquids had been set aside—an escape of gas analogous to the process of alcoholic fermentation. The gas collected extinguished burning bodies, but was not absorbed by potassa, whence it was provisionally supposed to be nitrogen. Similar results were then obtained with salts of soda, and in presence of phosphoric acid.

Process for Artificially Cooling Considerable Volumes of Air by Contact with a Cooled Liquid.—MM. Mignon and Rouart.—The apparatus employed consists of a three-necked bottle, at the bottom of which is a layer, of 0·05 metre in thickness, of a concentrated aqueous solution of calcium chloride. The bottle is immersed in a freezing mixture: one of the necks serves for the entrance of the air, another for its exit, whilst the third serves for the insertion of a thermometer.

Chloride of Silver Battery of 3240 Elements.—MM. Warren de la Rue and H. W. Müller.—This battery is composed on the one part of 1080 elements, each consisting of a tube of glass 15·23 c. in length, and of 2160 elements formed of glass tubes of 12·75 c. in length only. All the tubes are 1·9 c. in diameter, and are closed with stoppers of vulcanised india-rubber, perforated with a hole near the edge to permit the introduction of a rod of amalgamated zinc, 0·48 c. in diameter, and 10·43 c. in length for the first 1080 elements, and 7·93 c. for the remainder. At the bottom of each tube powdered chloride of silver is placed, 14·59 grms. in weight, compressed strongly with wooden rods, a flattened silver wire having been first introduced to the bottom of the tube. The silver wires are covered in their upper part, above the chloride of silver, and up to the point where they emerge from the vulcanised stopper, with leaf gutta-percha to isolate them and preserve them from the action of the sulphur in the stoppers. The electromotor force of this battery is to that of a Daniell's battery as 1·03 to 1.

Central-Blatt für Agrikultur Chemie, Heft 9, September, 1875.

Proportion of Dust and Saline Matter in Snow.—G. Tissandier.—Taken from *Comptes Rendus*, 1875, No. 1 page 58.

Most Convenient Method of Preserving Ice and Snow.—Prof. Segelcke and Dr. Fjord.

Composition of the Clay and Greywacke Slate of Westphalia, and of the Soils Produced by its Decomposition.—Dr. J. König.—These slates, belonging to the Devonian system, form the principal rock in an extensive district of Westphalia. A sample of the rock contains—

Ferric oxide and alumina	22·759
Ferrous oxide	4·855
Phosphoric acid	0·181
Lime	0·148
Magnesia	3·142
Potash	2·651

The soil formed from its decomposition contains—

Ferric oxide and alumina	18·529
Ferrous oxide	2·997
Phosphoric acid	0·147
Lime	0·297
Magnesia	2·415
Potash	2·554

13·194 per cent of the soil was soluble in concentrated hydrochloric, and 27·394 per cent in sulphuric acid.

Baker Guano Compared with Enderbury and Raza Guano.—Dr. C. Schumann, Dr. Heiden, and M. Voight.—Enderbury and Raza guano are superior to the true Baker guano, and may be regarded as the best raw material for the manufacture of superphosphate at present in the German market. It is impossible for the phosphoric acid when once rendered soluble to go back, and the small proportion of chloride of magnesium ensures the manufacture of a dry article.

Investigations on the Amounts of Carbonic Acid Excreted in the Breath and Perspiration by Different Animal Species under the same Conditions, and by the same Species under Different Conditions.—Dr. Pott.—The greatest amount of carbonic acid per 100 grms. of living weight is excreted by birds (4·93 grms. in six hours): next follow mammals (2·95 grms. in six hours), and then insects. Young animals excrete a proportionately greater weight than old ones.

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MISCELLANEOUS.

The Royal Society.—A Royal Medal has been awarded this year to Mr. William Crookes, F.R.S., for his various chemical and physical researches, more especially for his discovery of Thallium, his investigation of its compounds and determination of its atomic weight, and for his discovery of the Repulsion referable to Radiation. The other awards are—The Copley Medal to Prof. A. W. Hofmann, F.R.S., for his numerous contributions to the science of Chemistry; and especially for his researches on the derivatives of Ammonia; A Royal Medal to Dr. Thomas Oldham, F.R.S., for his long and important services in the science of Geology. It is hoped that Dr. Hofmann may be spared from Berlin for a few days, so as to receive the medal in person. The medals will be presented at the Anniversary Meeting of the Society, on the 30th inst.

MEETINGS FOR THE WEEK.

SATURDAY, Nov. 13th.—Physical, 3.
WEDNESDAY, 17th.—Meteorological, 7.
—— Geological, 8.
THURSDAY, 18th.—Chemical, 8. "Ethyl-phenyl Acetyline," by T. M. Morgan. "On the Presence of Liquid Carbon Dioxide in Quartz Cavities," by W. N. Hartley. "Addendum to the paper entitled 'Monthly Examination of the Harrogate Spas 1872,'" by R. H. Davis. "On certain Bismuth Compounds," by M. M. Pattison Muir. "On the Formation of Coumarins, Coumaric, and other similar Acids," by W. H. Perkin." "Communications from the Laboratory of the London Institution: (*a*) 'On the Action of Potassic Sulphite on the Haloid Derivatives of Phenol;' (*b*) 'Note on the Action of Nitric Acid on Tri-bromo-phenol,'" by H. E. Armstrong. "On Narcotine, Cotarnine, and Hydro-cotarnine," by G. A. Beckett and Dr. Wright. "On the Decomposition of Alcohol and its Homologues by the Joint Action of Aluminium and its Halogen Compounds," by Dr. Gladstone and Mr. Tribe.

TO CORRESPONDENTS.

ERRATA.—Vol. xxxii., page 219, lines 27 and 30 from top, *for* "N" *read* "U."

A Subscriber to the CHEMICAL NEWS.—Consult Wagner's "Chemical Technology," published by J. and A. Churchill.

H. Payne.—The better way will be to send the Act of Parliament.

P. Clavel.—We do not know of any.

The Committee of the Fund now being raised for the Family of the late Dr. SCHENK, F.C.S., begs to acknowledge the following sums received or promised since the 4th instant:—

J. Williams	..	..	£2	2	0	G. Vacher	.. .. .. £5	0	0
M. J. Lansdell	..	..	1	1	0	Prof. Odling	 3	3	0
Prof. Balfour Stewart	..		2	2	0	J. B. Hannay	 1	1	0
J. Newlands	.. ..	..	2	2	0	B. E. R. Newlands	.. 2	2	0
Dr. Gilbe t	.. ..	..	3	3	0	G. W. Arnott	 1	0	0
R. Johnson	.. ..	..	5	0	0	Sir B. Brodie	 3	3	0
W. Baker	.. ..	..	1	1	0	D. Forbes	 2	2	0
T. Charlesworth	.. ..		1	0	0	W. Noel Hartley	 2	0	0
R. Warington	.. ..	..	1	1	0	Dr. W. M. Watts	 1	0	0
W. H. Balmain	.. ..	..	1	1	0	G. T. Glover	 1	1	0
Dr. R. Fresenius	.. ..		2	0	0	Priest and Son	 0	10	6
Prof. Heaton	.. ..	..	1	1	0	Dr. Angus Smith	 3	3	0
H. Watts	.. ..	..	2	2	0	J. Mason	 5	0	0
Dr. Letheby	.. ..	..	2	2	0	Dr. Longstaff	 2	0	0
W. M. Henry	.. ..	..	5	0	0	W. Thomson	 2	2	0
R. J. Friswell	.. ..	..	1	1	0	Sidney Lupton	 1	1	0

The Committee will gladly receive further contributions.

ALFRED TRIBE, Hon. Sec.

Royal Institution, London, W.,
November 9th.

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No. VXII., November 1st, contains:—

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THE CHEMICAL NEWS.

VOL. XXXII. No. 834.

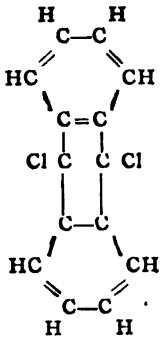
ALIZARIN FROM ANTHRACEN-SULPHO-ACID.

By G. AUERBACH.

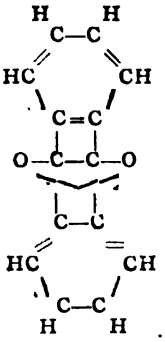
AMONGST the patents taken out up to the present time for the manufacture of artificial alizarin there are three by which one obtains anthraquinon-sulpho-acid by oxidising anthracen-sulpho-acid. It is thought that these methods simplify the old methods (oxidation of anthracen into anthraquinon), and are not used because our raw materials are not to be obtained pure enough; but, I think, if we could obtain in quantity a chemically pure anthracen, it would not be theoretically possible to obtain alizarin by these methods.

My reasons for thinking so are the following :—

If anthracen is treated with chlorine, one obtains a body which contains, instead of two hydrogen atoms, two atoms of chlorine (dichlor-anthracen). With any oxidising agent—chromic acid, peroxide of manganese, &c.—we obtain chlorine and anthraquinon ; therefore we see hat chlorine is eliminated and oxygen takes its place, which shows that the chlorine in the dichor-anthracen must take the place of the oxygen in the anthraquinon, as the following formulæ shows :—



Dichlor-Anthracene.



Anthraquinon.

If we treat this dichlor-anthracen with sulphuric acid, we first obtain, as Perkin shows, a dichlor-sulpho-anthracenic acid, which, by further treatment with sulphuric acid, oxidises the chlorine atoms, oxygen takes the place of chlorine, sulphurous acid is given off, and we obtain anthraquinon-bisulpho-acid.

If we oxidise anthracen-sulpho-acid, we do not get anthraquinon, but an anthraquinon-sulpho-acid. We have no reason to think that sulphuric acid takes any other place in the anthracen than the chlorine, and that, in oxidising anthracen-sulpho-acid, the sulphuric acid changes its place for oxygen. On the contrary, the oxygen must have another position in this anthraquinon-sulpho-acid than in that obtained by treating anthraquinon with sulphuric acid. The first anthraquinon-sulpho-acid cannot be identical, but only isomeric, with the anthraquinon-sulpho-acid obtained from anthraquinon and sulphuric acid. One does not obtain alizarin from one of these methods; one obtains red sulpho-salts, and, by melting with potash, a violet melt, which, after precipitation, contains only slight traces of colour, and settles, after standing, as a dark brown smear, which melts under water and is also soluble in water.

Greenford Green, Harrow, Middlesex.

NOTE ON A CORNISH SPECIMEN OF WAVELLITE.*

By J. H. COLLINS, F.G.S.

THE mineral wavellite, a hydrous phosphate of alumina, is of considerable interest to the mineralogist, although it has not hitherto occurred in such quantities as to be commercially valuable as a source of phosphoric acid. It was originally discovered by Mr. J. Hill, of Tavistock, about the year 1785, by whom it was found in rounded concretions resting upon clay-slate at Filleigh, near Barnstaple. It was about thirty years later analysed by Dr. Wavell, and named after him. It has also occurred in Northumberland, Scotland, Ireland, and many foreign localities—usually upon clay-slate or sand-stone.

Its occurrence in Corwall has been several times reported and as often disputed. Thus in Greg and Lettsom† at page 80, it is said to occur on a decomposing granite at Stenna Gwynn, near St. Austell, often accompanied with fluor and the rare mineral fluellite.

I have now the pleasure of corroborating this statement, and of presenting to the Royal Institution of Cornwall a small specimen from that locality, which was lately placed in my hands for analysis by Mr. Richard Talling, of Lostwithiel, from whom also Messrs. Greg and Lettsom had their information. I was not able to use more than 1½ grains for this purpose, but, although this was not enough to allow of a quantitative analysis, I was able very well to determine the presence of all the essential constituents of wavellite. It will be seen that the specimen is really upon a granite rock, unlike the specimens from other localities, but it is not, I regret to say, in this instance, associated with the extremely rare fluellite.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.‡

By Dr. A. W. HOFMANN.

(Continued from p. 231.)

BALLOONING had been made subservient to the purposes o meteorology and physics before it was enlisted in the service of the war-spirit. Charles utilised his expedition for scientific purposes. On July 18, 1803, he was imitated by Robertson, who ascended from Hamburg to the height of 7400 metres, and who imagined that he perceived at this altitude a decrease in the intensity not merely of terrestrial magnetism, but also of frictional electricity. These statements induced the great physicists Biot and Gay-Lussac to undertake two ascents the next year. They refuted the above-mentioned views of Robertson, remarked the decrease of atmospheric moisture with increasing altitude, and made numerous and valuable meteorological observations. From the greatest height which they attained, 6500 metres, Gay-Lussac brought back a specimen of air, and found that it had the same composition as the air of lower regions—a result, at that time, of capital importance. The last-mentioned ascents were all made with hydrogen gas. As the use of gas-lighting became more and more general the greater power which the lightest of all known bodies offers was sacrificed to the convenience which coal-gas afforded. In France, Barral and Bixio made their scientific ascent in 1850 with the aid of coal-gas. In England Glaisher adopted the same plan in 1864, and the numerous balloon voyages which have been made for the amusement of the public from the love of adventure or for some especial purpose, have been undertaken with the same material. With

* From the *Journal of the Royal Institution of Cornwall.*

† "Manual of the Mineralogy of Great Britain and Ireland."

‡ "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

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[illegible] from Orleans to Amiens, from London to Ostend, a distance as the crow flies of 200 miles, a balloon left Paris on the 24th December, 1870, at 9.30 A.M., and descended at 2.30 P.M. on the following day in Norway, 620 miles from Paris, after a journey of 29 hours. Other balloons have since made the same journey in a shorter time, but none have ever been known to descend at a greater distance from the point of departure. Other balloons have risen to greater heights, and have remained longer in the air, but this balloon was the first to attempt a regular journey from Paris to Ostend. Object of trip. More recently balloons have been used to the use of hydrogen. But even in the best manner of the gas the edge of a meteor is of which history speaks. When Paris remained entirely for its intercourse with the outer world upon carrier pigeons and balloons, a fact has never before been found to be important a service, even when necessity compelled the use of balloons, it was practicable with the least difficulty." 65 balloons went up from Paris between September 23 and January 22, carrying 91 passengers, 363 pigeons, and 2½ millions letters, and for the most part with success. Only 5 balloons fell into the hands of the German armies: one descended in Munich; another at Wetzlar; one disappeared entirely, perhaps in the sea; whilst the fragments of another were found in the autumn of 1873 clinging to a tree at Port Natal in south-eastern Africa. All the others descended safely beyond the radius of the besieging army in France or upon neutral territory: one in Belgium; three in Holland; and one upon a snow-field in Norway, 620 (German) miles to the north of Christiania, and 1560 from Paris, which had been traversed in fifteen hours.*

(To be continued.)

ON THE ACTION OF SULPHOCYANIDES ON PALLADIUM CHLORIDE AND NITRATE.

By SERGIUS KERN, St. Petersburg.

PALLADIUM chloride is used sometimes as a reagent for the detection of iodine, giving palladium iodide (PdI_2) a black precipitate insoluble in water; this reaction is a very delicate one. Studying the action of alkaline sulphocyanides on some metallic compounds of the platinum group, I observed that by mixing aqueous solutions of palladium chloride and potassium or ammonium sulphocyanide a soluble palladium sulphocyanide is formed; the liquor, meanwhile, from a reddish-brown colour turns red.

The resulting sulphocyanide of palladium is a very stable compound, in which the presence of the palladium is not easily detected. Thus an alcoholic solution of iodine gives no black precipitate of palladium iodide. Palladium nitrate [$Pd(NO_3)_2$] with potassium sulphocyanide also yields palladium sulphocyanide.

Palladium chloride being often used in qualitative analysis for the detection of iodine, and palladium nitrate for the separation of iodine from chlorine and bromine, it is easily understood from this small research that the presence of sulphocyanides in the analysed liquors must be avoided, because if they are present faulty results may be obtained.

THE CHEMICAL CONSTITUTION OF THE CHLORINATED METHYL & ETHYL ETHERS, AS ALSO OF THE CHLORINATED COMBINATIONS OF THESE ETHERS WITH FORMIC, ACETIC, OXALIC, AND CARBONIC ACIDS,

VIEWED AND INTERPRETED FROM THE STANDPOINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

My researches into the chemical constitution of the ethyl ether and its chlorinated derivatives have culminated in a new theory, which supported as it is by a host of well-established facts, will not be deemed unworthy of an extensive and minute examination. Prominent in a theory of more fully developing and substantiating the theory. I have not been sure in gathering a series of valuable observations with the aid of which I hope in the course of a short and powerful light upon certain intra-molecular changes and the metamorphoses which chlorine in its capacity of a substitution reagent is best to superintend upon the particular group of organic molecules that forms the theme of the coming remarks.

In preceding my programme, I have found it advisable to divide the chloro-derivatives of the ethers under two separate classes. The first class is made to comprise all those chloro-derivatives in which the number of substitutable hydrogen molecules amounts to one, or more than one: while the second class is made to comprise those chloro-derivatives in which the whole of the component hydrogen molecules has been replaced by an equal number of chlorine molecules.

Accordingly, my programme will consist of the following two parts:—In the first part, I shall expound the molecular changes attending the formation and transformation of that set of chemical compounds which fall under the first class of chloro-derivatives: and in the second part I shall expound the molecular changes attending the formation and transformation of that set of chemical compounds which fall under the second class of chloro-derivatives. With these few statements, I shall now call upon the reader carefully to ponder the contents of the first part of my programme.

PART I.

On the Principal Molecular Changes attending the Formation and Transformation of that Set of Chemical Compounds which fall under the First Class of Chloro-Derivatives.

A. *Chloro-Derivatives of the Methyl-Ether.*—Taking it for granted that the action of chlorine on this ether is precisely similar to its action on the ethyl-ether (vide CHEMICAL NEWS, vol. xxxi., p. 245), the chemical constitution of the mono-chloro-methyl-ether will be expressed by the formula—

$$\begin{matrix} Me_2O_2. \\ Sfo_2Cl_2,Sfo_2O_2, \end{matrix}$$

which represents it as the mono-methyl-ether of the biatomic methyliden-oxychloride. It would be easy to test the correctness of this view by treating the ether with sodium-methylate, when the resulting product ought to be methylal—

$$\begin{matrix} Me_2O_2.\ Me_2O_2. \\ Sfo_2O_2,Sfo_2O_2, \end{matrix}$$

which is an ethereal liquid occurring among the distillation products of pyroxylic spirit with oil of vitriol and peroxide of manganese.

Passing on to the dichloro-methyl-ether, its formula will be—

$$\begin{matrix} Me_2O_2. \\ \overline{Me_2O_2}, \end{matrix}$$

if we suppose the molecular changes to consist in the substitution of a molecule of chlorine for one of hydrogen in the regenerated chloro-methylen adjunct. This compound, again, after merging into the isomeric modification—

$$\begin{matrix} Me_2O_2. \\ 2FOCl_2O, \end{matrix}$$

would then, by the further action of chlorine, produce in succession the tri-, tetra-, and penta-chloro-methyl-ethers, with the respective formulæ—

$$Me_2O_2. \quad \overline{Me_2}O_2. \quad \overline{Me_2}\overline{O_2}.$$
$$2\overline{F}oCl_2O, \ +2\overline{F}oCl_2O, \text{ and } 2\overline{F}oCl_2O.$$

It remains to be seen to what extent these theoretical anticipations are verified by future experiments.

* Saint Rémy, "La Science pendant le Siége de Paris," 1871, 62.
† Stephan, *Weltpost und Luftschiffahrt*. Berlin, 1874.

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B. *Chloro-Derivatives of the Ethyl-Ether.*—In the paper above referred to I have already had occasion to enlarge on the first four chloro-derivatives of the ethyl-ether, to the last of which I assigned the formula—

$$\begin{matrix}Et_2O_2.\\ Fo_2Cl_2,2\overline{F}oCl_2O.\end{matrix}$$

Assuming that, under the stimulus of chlorine, this compound is first made to merge into the isomeric modification—

$$\begin{matrix}Et_2O_2.\\ 2\overline{A}\overline{c}Cl_2O\ (2Ac=2H_3C_2\,;\,2C_2),\end{matrix}$$

the interchange of chlorine for hydrogen in the regenerated dichloro-methyl adjunct will give rise to the penta-chlor-ethyl-ether—

$$\begin{matrix}Et_2O_2.\\ 2\overline{A}\overline{c}Cl_2O,\end{matrix}$$

clearly showing that henceforth the substitutional action of chlorine will be confined to the ethylen adjunct of the ether base. Passing over the intermediate substitution-products, we arrive at the last member of our series, viz., the ennea-chlorethyl-ether, the chemical constitution of which will be adequately expressed by the formula—

$$\begin{matrix}\overline{Et_2O_2}.\\ 2\overline{A}\overline{c}Cl_2O.\end{matrix}$$

A. (1). *Chloro-Derivatives of Methylic Formate.*—So far as I am able to gather, not a single one of the possible chloro-derivatives of this ether-salt has yet been obtained in a fit state for analysis; it is, however, worthy of notice that the methylic chloro-formate may be got synthetically, that is, by the action of phosgen on methylic alcohol, according to the equation—

$$2\overline{F}oO_2,Cl+Me_2O_2=2\overline{F}oO_3+H_2Cl_2,$$

where it is plain that the molecular changes consist in the interchange of methoxyl for chlorine.

B. (1). *Chloro-Derivatives of Ethylic Formate.*—Like the preceding compound, the ethylic chloro-formate has been got by synthesis only, viz., by the action of phosgen on ethylic alcohol. Among the other possible varieties, I may mention the chlorethylic chloro-formate—

$$\begin{matrix}\overline{Et_2O_2}.\\ 2\overline{F}oO_3,\end{matrix}$$

which, with solution of potash, gives formate and acetate. In this metamorphosis, the newly-formed chlorethylic alcohol is first made to merge into the isomeric hydrate of ethyliden-oxychloride—

$$\begin{matrix}H_2O_2.\\ Fo_2Cl_2,Me_2O_2,\end{matrix}$$

whereupon the two molecules of hydrogen, which the alkali has helped to expel from the methylen adjunct, by acting substitutionally on the chlorine adjunct of the chloroformate, give birth to a molecule of formate. At the same time, the newly-formed chloraldehyd becomes oxidised into chloracetate at the expense of 2 molecules of water, while the liberated hydrogen, by its substitutional action on the chloracetate, effects its conversion into acetate.

A. (2). *Chloro-Derivatives of Methylic Acetate.*—There exists a dichloro-derivative, which may be viewed as chloro-methylic chloracetate or as dichloro-methylic acetate. With potash-lye this compound is observed to resolve itself into formate and acetate, through the following series of molecular changes. In the first view, the newly-formed chloro-methylic alcohol, after passing into the isomeric hydrate of methyliden-oxychloride—

$$\begin{matrix}H_2O_2.\\ Sfo_2Cl_2,Sfo_2O_2,\end{matrix}$$

splits up into hydrochloric acid and formite of water (form-aldehyd), which then becomes oxidised into formate at the expense of 2 molecules of water, while the liberated hydrogen transforms the chloracetate into acetate. In the second view, it is clear that the formate must be due to the action of the alkali on the isomeric modification—

$$\begin{matrix}H_2O_2.\\ 2FoCl_2O,\end{matrix}$$

of the newly-formed dichloro-methylic alcohol; but, as regards the acetate, the reason of its occurrence is sufficiently obvious and self-evident. There exists also a trichloro-derivative, which may be viewed as dichloro-methylic chloracetate or as chloro-methylic dichloracetate. The decomposition products of this compound by solution of potash are formate and an oily matter, which, by its formula, Fo_2Cl_2, is evidently formyl-chloride, both these substances being set at liberty by the splitting up of the pre-existing (first view) or newly-formed (second view) chloracetate into its two principal components. It is, further, clear that the second molecule of formate must derive from the newly-formed dichloro-methylic alcohol (first view), or else from the formite of water (second view), in the manner previously explained.

B. (2). *Chloro-Derivatives of Ethylic Acetate.*—Under this head, I shall notice, first, the chlorethylic chloracetate, which, with solution of potash, gives 2 molecules of acetate, where the molecular changes consist successively in the splitting-up of the newly-formed chlorethylic alcohol into the isomeric hydrate of ethyliden-oxychloride, the expulsion of 2 molecules of hydrogen from the methylen adjunct, and their substitutional action on the chloracetate, with formation of acetate; while the other molecule of acetate derives from the simultaneously-generated chloraldehyd, as explained under B. (1). I shall, further, notice the dichlorethylic chloracetate, which, with solution of potash, is said to furnish acetate, chloracetate, and an oily matter that, from its probable identity with the before-mentioned formyl-chloride, ought to be accompanied by a corresponding quantity of formate. The reader, by taking his cue from the preceding explanations, will not be at a loss to trace the molecular changes of this interesting, but, as yet, imperfectly investigated reaction. Passing over the tetra, penta, &c., chloro-derivatives, regarding which little is known beyond their empirical formulæ, it will be more expedient to review *en masse* the compounds falling under the sections $A,3\div B,3\div A,4\div B,4$, and which comprise the chloro-derivatives of the methylic and ethylic oxalates and carbonates. From the circumstance that the replaceable hydrogen molecules are all contained in the hydrocarbon adjunct of their respective ether bases, I am led to anticipate that the decomposition-products of the primarily-formed chloro-methylic and chlorethylic alcohols will consist of the aldehyds and acids that are moulded on the formyl-, acetyl-, and glycolyl types.

In commenting on the class of chloro-derivatives before us, I may observe that they have all this important feature in common, that during the many and divers phases of substitutional metamorphosis they have each and all continued to preserve the original type of ether-salt molecules, and this up to the point, when there is spared to them but one single molecule of hydrogen. Now I have no hesitation in maintaining that that particular hydrogen molecule has all along withstood the substitutional attacks of chlorine, simply and solely because it has never ceased to discharge in these molecules the well-defined duties and functions of a basic hydrogen nucleus. And here the reader will not fail to recall one of the chief characteristics of all basic nuclei, to wit, that the chemical materials out of which these nuclei are formed are invariably taken from among the electro-positive metals; and, furthermore, that, while such basic nuclei are constitutionally qualified to exchange places with one another, they are absolutely incapable of transposing with non-metallic elements, like chlorine, for example.

Having now impressed the reader with the deep import of these theoretical distinctions, I shall invite him to accompany me to the second part of my programme

where I purpose enquiring into the special terms and conditions on which the last remaining molecule of hydrogen becomes freely replaceable by chlorine, so as to give birth to our second class of chloro-derivatives, wherein the original type becomes completely obliterated and supplanted by another and totally different type, it being experimentally demonstrable that the thus altered molecules have passed from the category of organic ether-salts into the category of anhydrous organic acids.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

November 13th, 1875.

Professor GLADSTONE, F.R.S., President, in the Chair.

THE PRESIDENT stated that since the last meeting of the Society Professor Everett's important work, "On the Centimetre-Gramme-Second System of Units," had been published by the Society. The book is based on the recommendations of a Committee of the British Association, and consists of a collection of physical data concisely presented on the above system, a complete account being added of the theory of units.

Dr. STONE then read a paper "*On Thermopiles.*" He has recently been engaged in some experiments with a view to ascertain the best alloy for use in thermopiles. The thermo-electric power of a metal or alloy appears to be quite unconnected with its power for conducting heat or electricity, or with its voltaic relation to other metals, neither does it appear to have any relation to specific gravities or atomic weights. The thermopiles employed were of a form slightly modified from that employed by Pouillet in his demonstration of Ohm's law. Alloys are frequently more powerful than elementary metals; thus, 2 parts of antimony and 1 part of zinc have a negative power represented by 22·70, while that of antimony is 6·96 or 9·43, and that of zinc is 0·2. A strange exception, however, is that of bismuth and tin; for, while the power of pure bismuth is +35·8, when the two metals are alloyed in the proportion of 12 to 1, the power becomes −13·67. Dr. Stone first used a couple consisting of iron and rich German silver (that is, rich in nickel). This was characterised by great steadiness, but the electromotive force produced by moderate differences of temperature was not great. He then used Marcus's negative alloy, consisting of 12 parts of antimony, 5 of zinc, and 1 of bismuth, but the crystalline nature and consequent brittleness of this mixture were found to be great objections to its practical use. It occurred to Dr. Stone that the addition of arsenic might diminish the brittleness without injuring the thermo-electric power; and, on trial, it was found that an alloy of zinc, antimony, and arsenic, with a little tin, formed a much less brittle mass than Marcus metal, with quite as great, or greater, thermo-electric power. A set of twelve couples of this alloy and German silver was exhibited. The electromotive forces of this set, and of a similar one of 12 iron and German silver couples, were determined by Mr. W. J. Wilson, and found to be, for one alloy and German silver couple, with difference of temperature of 80° C., $\frac{1}{10}$th of a Daniell's cell. The electromotive force of one couple of the iron and German silver set was $\frac{1}{11\frac{1}{2}}$th of a Daniell's cell. The ordinary method of applying heat by a trough of hot water is objectionable, for the water short-circuits some of the current. This is evident from the fact that, if oil heated to the same temperature be substituted, a considerably greater deflection is obtained. Another method suggested by the author, which would tend to economy, is to allow petroleum to volatilise in the neighbourhood of one face of the pile, thus chilling it, and to ignite the mixture of air and gas so produced at the other face. Clamond's pile, consisting of iron and an alloy of zinc and antimony, was employed for some time, but, although good results were obtained, the iron is liable to rust at the connections.

Dr. GUTHRIE remarked that, in researches of this nature, the main object in view was to ascertain what relation, if any, existed between the direction of the current and the amount of heat flow. He referred to the experiment with a tangle of fine platinum wire, by which it is found that, if either end of the wire be heated, a current flows towards the tangle, and this takes place however well the tangle may be annealed. He suggested that the great effect which alloying one metal slightly with another has on its position in the thermo-electric series may, perhaps, be connected with its change in conducting power for heat.

Mr. WALENN referred to experiments which he made couple in which amalgamated copper was employed, some years since on thermopiles when used at high temperatures. The most powerful currents were obtained with a but the power was soon lost, in consequence of the volatilisation of the mercury. Subsequently, he employed wires of wrought-iron and German silver, and, although the results were not specially remarkable at moderately high temperatures, the power became great when the connections were raised to a red heat.

Professor FOSTER called attention to Matthiessen's "Table of the Electric Conductivities of Metals and Alloys," in relation to the use of the latter in thermopiles. The fact shown by Matthiessen, that the conductivities of alloys are greatly influenced by changes of temperature, will probably, he considers, be found to have some connection with their thermo-electric action. He also mentioned, as a fact which should be remembered when considering the construction of thermopiles, that the presence of minute traces of impurity completely changes the electric conductivity of a metal.

SOCIETY OF PUBLIC ANALYSTS.

OBSERVATIONS ON THE MILK OF THE COW IN DISEASE.

By A. WYNTER BLYTH, F.C.S.,
Analyst for Devon.

1. *Ecthæma Epizootica.*

IT has long been observed that in both our own epizootics of foot and mouth disease, as well as in those of Germany and the Continent, that the milk of the cow during the first three days of the malady is occasionally fatal to calves and pigs,* and recent experiences have fully confirmed this fact, at once curious and important.

This fatality is by no means uniform, and only occurs in a few cases, but in all the symptoms are remarkably similar. The animal in the midst of apparent health, is as suddenly taken ill, and the illness is as immediately followed by death, as if a fatal dose of a violent poison had been administered.

If the pathological changes found after death afford us little insight into the mystery of the attack itself, they at all events show the immediate cause of death, which is suffocation.

I have recently had an opportunity† of observing the *post mortem* appearances in a calf which thus died after suckling its mother, with extreme suddenness. The base of the tongue and the larynx was intensely swollen and congested, the bronchial tubes were completely choked by a viscid frothy mucous, the true stomach was deeply congested as well as the kidneys, and the intestines were of a rose

* *Comptes Rendus*, Zurich, 1846; Petri, *Annales des Brussels*, 18..

† Through the kindness of Mr. Gregory, M.R.C.V.S., Bideford.

colour; there were also a few aphthous patches on the tongue.

It would, then, appear that the warm milk acts first as a local irritant, and then the specific germ of the disease is carried into the blood, and determines to the lungs, kidneys, and tongue: the gorged kidneys no longer fulfil their office of depuration; there is an excessive outpour of fluid into the bronchial tubes; and the animal dies, for the most past suffocated, but partly also from the impure blood circulating in the nervous centres.

With regard to the milk itself, which is thus so suddenly converted from Nature's nourisher to Nature's destroyer, the whole of the knowledge which we at present possess upon the subject may be summed up in two brief sentences.

(1). The milk mostly, but not invariably, contains abnormal microscopical elements of unknown significance.

(2). The milk mostly, but not invariably, yields to analysis percentages of its components which differ from those of healthy milk.

(1). *Microscopical Characters.*—If milk be taken on the first day of the disease, and microscopically examined, no abnormal elements whatever may be discovered in it; but, on the other hand, instead of the milk globules remaining free and separate, as is usually the case, they show a tendency to aggregate into groups; in other words, the first stage is *aggregation of the milk corpuscles*. About the third day some new elements, not hitherto described, make their appearance. These consist of elongated, flattened, highly refractive bodies, ranging in length from 1-8ooth to 1-10ooth of an inch. In some there are contractions at intervals, which at first sight might be mistaken for a division into cells, but this is not so; it would rather appear to be the contraction of a sarcode (?) material. These bodies are not perceptibly altered by dilute acetic acid or by iodine, nor are they stained by magenta. I have had no opportunity of ascertaining whether, whilst the milk is warm and fresh from the cow, any movement indicative of animal life is to be observed in them. On the fourth day, if they have not entirely disappeared, they are very few in number, and somewhat increased in size. These bodies are not found in the milk of the later stages.

After the third day, and continuing in some cases for a period of a week, or even much longer, pus cells, large granular bodies, vibriones, bacteria, epithelial-like cells, and *débris* are very constantly seen. I believe most of them are obtained by the dropping of the discharges from unhealed ulcers on the teats of the animal into the milk.

Composition of the Milk.—The following table well illustrates the varying characters of the milk. It will be noticed that in some instances the fat may be said to be almost entirely absent. This deficiency of fat may continue for at least a week, and may be associated with a deficiency of caseine and a deficiency of salts; hence the *milk solids not fat* may fall below 9·0 per cent, a fact which must not be distorted by interested persons to apply in any way to normal milk: I am writing here of a product which is profoundly altered. The percentage of milk-sugar is sometimes much increased, but, as a rule, it is but little affected. All the analyses quoted are those of milks taken in each case from different animals:—

	Water.	Fat.	Caseine.	Milk-Sugar.	Ash.	Solids not Fat.
Average of healthy milks	87·550	3·070	4·160	4·760	0·730	9·650
Milk from a cow on the 1st day of the disease ..	91·239	0·390	2·899	4·809	0·663	8·371
" " " 2nd day " ..	79·903	5·010	14·380		0·707	15·087
" " " 2nd day " ..	86·320	3·838	9·135		0·707	9·842
" " " 3rd day " ..	87·676	0·891	3·948	7·152	0·333	11·433
" " " 4th day " ..	83·852	7·798	3·469	4·669	0·212	8·350
" " " 5th day " ..	87·900	1·062	10·376		0·662	11·038
" " " 7th day " ..	86·067	1·587	10·849		0·507	11·356
" " " 14th day " ..	83·882	3·961	11·478		0·679	12·157

Barnstaple, October 26, 1875.

NOTICES OF BOOKS.

Discoveries and Inventions of the Nineteenth Century. By R. ROUTLEDGE, B.Sc., F.C.S. London: G. Routledge and Sons.

THE object of this volume, as the title explains, is to give an account of some of the discoveries and inventions which have characterised the present century. To have given an account of all would have been manifestly impossible, and a selection has therefore become necessary. It seems to us, however, that the author has given too much prominence to mechanical and engineering performances, and given a subordinate place to chemistry. We certainly think that the modern development of the alkali manufacture, with its collateral branches, the preparation of artificial manures, the production of artificial ultramarine, the discovery of the Stassfurt salts, the industrial applications of chrome, the introduction of animal mordants, the isolation of quinine, and indeed many more discoveries that might be mentioned, have had quite as much "direct bearing on the general progress of our age" as "Pepper's ghost." Yet while such a trifle occupies four pages and as many illustrations, the subjects above mentioned have not been thought worthy of mention.

Light-houses, coal, gold, and diamonds, however important, can scarcely be claimed as the exclusive property of the nineteenth century.

With these exceptions the book may be pronounced a creditable performance. The descriptions are clear, and, as far as we have observed and are capable of judging, correct. The information given is conveyed in an easy and familiar style which will commend itself to a large section of the public. It has been the author's aim not to assume on the part of his readers any knowledge no usually possessed by young persons of either sex who have received an ordinary education. The most ambitious, and perhaps the most truly valuable portion of the work, is an an attempt to give a popular view of the doctrines embodied in Sir W. Grove's "Correlation of Physical Forces." The author is quite right in supposing that no attempts have yet been made to introduce these important truths to outsiders. Their profound significance and great educational value require that they should be made known far beyond professional and scientific circles, and we are well pleased that Mr. Routledge has taken the task in hand. His exposition of the conservation of energy is clearly and ably drawn up, and is illustrated by frequent reference to facts brought forward in earlier portions of the work.

The book is handsomely got up, profusely illustrated, and provided with a copious index.

Magic Lanterns: How Made and How Used. By A. A WOOD, F.C.S. London: C. G. Wood, 74, Cheapside.

THE appearance of this little book warns us of the approach of Christmas. The magic lantern in skilful

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hands may be made to afford an almost exhaustless fund of amusement, and at the same time much much valuable instruction. All persons who calculate upon displaying this instrument under any of its modifications, whether in private or in public, will find here full and intelligible instructions for its management. We notice here also a brief biographical notice of Henry Langdon Childe, the inventor of dissolving views and of the chromatrope.

There is an interesting selection of chemical, optical, magnetic, and galvanic experiments arranged for exhibition to an audience by projection on the screen.

Among the list of "subjects for lectures" to be illustrated by the magic lantern the author proposes "The North Pole and how to get there." This theme, we should think, will be much easier to handle when some one has actually got there and has given us an account of his experience.

Annual Report of the Director of the Mint for the Fiscal Year ended June 30, 1874. Washington: Government Printing-Office.

This report contains much curious information on monetary standards, on the amount of gold and silver coin and bullion in the world, and the coinage laws of all nations.

The most interesting portion, in a scientific sense, is the report of Mr. W. E. Dubois on the spectroscopic assay of gold alloys. The results, as obtained by Mr. A. E. Outerbridge, an experienced and skilful spectroscopist, are unfavourable. Where two metals are present the electric spark chooses for its vehicle the one which is most rapidly vapourised. Hence, though $\frac{1}{10000}$th of a milligramme of gold will show a spectrum—when the gold is pure—in an alloy of silver and copper containing 3·8 per cent of gold, the latter is not indicated by the spectroscope at all: 20 per cent of nickel in an alloy of nickel and copper is likewise not detected. Another of the Mint assayers, Mr. H. G. Torrey, likewise reports that—"The lines are not of uniform width from end to end, but run to a point and fade out so gradually that the point of termination is by no means certain. An unequal delivery of the spark involves inequality in the length and brightness of the lines. The lengthening or shortening of the lines does not correspond with the increase or decrease of the proportion of precious metal present." The want of absolute homogeneity in the plates and ingots to be assayed would also constitute a serious difficulty, even if every other objection could be removed. Hence the writers consider that the success of quantitative spectroscopic analysis can scarcely be anticipated.

CORRESPONDENCE.

WATER ANALYSIS.

To the Editor of the Chemical News.

Sir,—The following correspondence is a painful instance of how analytical chemists differ. It is really most sad and humiliating to our splendid science to think that, with all the improvements with which chemistry has been enriched within the last few years, true analytical work has not kept pace with the spirit of the age, or we should not find such great discrepancies in the works of those that follow the practice of analytical chemistry. "Who shall decide when doctors disagree?" When each chemist pursues his own method of working, which, in some instances may be erroneous, instead of adhering to some recognised plan, the question arises, Who is to decide between the conflicting methods now in use? Surely no better authority could we have than the Chemical Society. Let that body select a practical jury of twelve, to decide upon special processes for analytical work; let a compound or well-known composition be given to the jury to analyse; then, if they one and all return the analyses according to the composition, we may safely infer that the process by which such results have been brought out is a good one, and that in future compounds must be analysed by the particular method selected. And if chemists would adhere to the rules laid down, perhaps then we should not hear of such a discreditable case as the following, where five chemists analyse a water, and three report it good and two very bad:—

Some time since, the directors of a large institution near London sank a well between three and four hundred feet deep. When finished, the water was analysed, and pronounced by chemist A to be good. In June of this year the directors thought fit to have the water again examined; it was now analysed by a noted commercial analytical firm, B, who condemned the water. This report alarmed the directors, and they again, in the same month, sought the aid of another chemist, C, who was an M.D. The water was condemned in still stronger terms. Things were now looking serious; but, before the directors closed the well, over which they had spent a large sum of money, they decided, in July, to have the water analysed by chemist D. The report received was most favourable; still they were in as great a difficulty as ever, because two reports gave the water as good, and two as bad. They were now obliged to make an appeal to chemist E, so that the balance of evidence might be upset. The report was again good.

Below, I give the reports and analyses of the five chemists:—

A.

I beg to report to you the result of my analysis of the sample of water sent to me.

The water is bright, free from colour, and remains perfectly good after prolonged keeping.

One imperial gallon contains in solution 27·5 grains of solid matter. The solid matter is composed as follows:—

	Grains in Gallon.
Carbonate of lime	15·800
Carbonate of magnesia	0·800
Sulphate of lime	6·500
Silica	0·600
Chloride of sodium	1·300
Nitrates of the alkalies and organic matter	2·500
	27·500

Hardness in its natural condition .. .. 23·0
„ after boiling for half-an-hour .. 7·0

The water exerts no action on metallic lead, and may therefore, be safely kept in leaden cisterns.

The ammonia in the water is extremely small, and the organic matter present is almost entirely in the oxidised, or non-putrescible condition. The small amount of chlorides indicates that little or no organic contamination of an animal origin finds access to the well.

I am of opinion that the water is of good quality, and well suited for drinking, cooking, or domestic purposes. Nevertheless, it is probable that the organic matter in the water will vary within certain limits, both in quantity and quality, and I should, therefore, recommend that, for drinking purposes, the water should be regularly filtered through animal charcoal.

B.

We hereby certify that we have examined the sample of water described below, and that the following is the result:—

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	Grains, Imperial Gallon.
Carbonate of lime	17·050
Sulphate of lime	0·500
Nitrate of lime	1·900
Nitrate of potash	0·400
Nitrate of soda	1·200
Muriate of magnesia..	1·050
Silica	0·700
Organic matter	traces
	22·800

We beg to enclose analysis of the sample of water. From this analysis we are of opinion that most probably it is surface-water, as it contains flocculent organic matter as well as organic matter dissolved in it. It is certainly not contaminated with sewage-matter, as, if this was the case, the percentage of muriate of soda would be very much larger. The percentage of nitrates is not large, and they are present in consequence of the water being, at any rate partially, collected from fields where nitrates have been used for manure. Taking all these circumstances into consideration, we are of opinion that this water is not suitable for drinking, as at certain seasons of the year, owing to the fields being dressed with manure, it would become far more impure; and we should strongly advise the directors to obtain their drinking-water from another source. Filtration would get rid, of course, of the flocculent organic matter, but would have no effect on the organic matter in solution.

C.

Analysis of water sent in a stone jar, corked and sealed:—

Grains per gallon	27·000
Chlorine	1·250
	Parts per Million.
Free ammonia	0·010
Albumenoid ammonia	0·100
	Grains per Gallon.
212° F.—Total solids	27
Ignited	15
Loss	12

No trace of lead, copper, or iron.

	(Clark's Scale.)
Temporary hardness	22·0
Permanent „	9·0

This water contains organic matter in such quantity as to render it unfit for domestic use. The contamination is not of very recent date; it is free from harmful metallic impurities; it is hard, but becomes soft by boiling. Until the source of pollution is removed, none of this water should be used without previous filtration.

D.

Analysis of water from well:—

	Grains per Gallon.
Total solid residue	24·1500
Chlorine	0·9100
Ammonia	0·0007
Nitrogen in the form of nitrites and nitrates	0·5870
Temporary hardness	12·8000
Permanent „	5·8000
Total „	18·6000

The amount of chlorine present is equivalent to 1·49 grs. per gallon of water. The water has no taste or odour, and contains no iron or lead. The hardness shows that there are present lime and magnesia salts, extent equivalent to 18·6 grains of carbonate of lime per gallon; of these, 12·8 grains per gallon exist as carbonates and are precipitated on boiling, leaving 5·8 grains of lime and magnesia salts other than carbonates (sulphates, nitrates, &c.) per gallon in solution.

The amount of oxidised nitrogen in the form of nitrates in the water is somewhat higher, but all the other indications of the analysis are those of a perfectly pure water. I should, therefore, consider this water quite fit for all domestic purposes.

Chemist D also sent the following note:—

"Dear Sir,—In answer to your enquiry by letter just to hand, I beg to state that I consider that (as far as chemical analysis can determine) the water from the well is fit to drink, and that it is not necessary either to boil or filter it previously to use."

E.

Analysis of water from the well:—

	Grains in Gallon.
Chloride of sodium	1·847
Chloride of calcium	0·025
Sulphate of lime..	4·360
Nitrate of lime	1·852
Carbonate of lime	16·948
Carbonate of magnesia	0·883
Oxides of iron and alumina ..	0·070
Silica	0·700
Permanent hardness ..	4·4
Temporary „ ..	17·9
Total „ ..	22·3
Free ammonia	0·000421
Albumenoid ammonia ..	0·000791

It will be seen, from the above results, that this water contains considerable quantities of both carbonates and sulphates of lime, which renders it harder than is desirable for washing and cooking purposes. Of the hardness, three-fourths, however, may be removed by boiling.

The quantities of free and albumenoid ammonia contained in this water are exceedingly small, and in this respect the water may be pronounced to be very pure. On the whole, it may be said that this water is rather too hard for cooking and washing, but it may be used with safety for drinking, although it is advisable, on account of its hardness, that it should be previously boiled.

The following note was sent with the analysis (E. analysed two samples):—

"Dear Sir,—Herewith I forward you my reports on the two waters. I am very glad that the results are so favourable; the waters are, indeed, unusually pure, but somewhat too hard.—I remain, &c."

This tabular statement will clearly show where they differ:—

	Solids.	Total Hardness.	Permanent Hardness.	Temporary Hardness.	Nitrates.	$CaSO_4$.	Cl.	$CaCO_3$.	SiO_2.
A.	27·5	23·0	7·0	16·0	2·500	6·5	0·78	15·8	0·6
B.	22·8	—	—	—	3·500	0·5	0·78	17·0	0·7
C.	27·0	31·0	9·0	22·0	0·587	—	1·25	—	—
D.	24·1	18·6	5·8	12·8	—	—	0·91	18·6	—
E.	26·6	22·3	4·4	17·9	1·852	4·3	1·27	16·9	

A.'s verdict is—That the water is of good quality.
B.'s „ —It is surface-water, and is bad.
C.'s „ —So much organic matter as to be unfit for drinking.
D.'s „ —A perfectly pure water, and quite fit for all domestic purposes.
E.'s „ —The water is unusually pure.

After such verdicts, surely it is necessary we should have some reforms in our practice of analytical chemistry.—I am, &c.,

J. Carter Bell.

20, East Corridor,
59, Mark Lane, London, E.C.

MANUFACTURE OF WHITE CAUSTIC SODA.

To the Editor of the Chemical News.

Sir,—Having observed in the Chemical News (vol. xxxii., p. 238) a letter signed "Black-Ash," where the correspondent seems surprised at the low percentage of sodium sulphate in the samples of black-ash A and B, given by

Mr. George E. Davis in his elaborate paper on the "Manufacture of White Caustic Soda" (see CHEMICAL NEWS, vol. xxxii., p. 176), I beg to mention the fact that I have frequently known the average of a whole shift's work from ten hand furnaces to be under 0·2 per cent of real sodium sulphate undecomposed, and that made by the use of slutched lime only, although the general work extending over several months would be on an average of about 1·2 per cent.

I noticed that the undecomposed sodium sulphate in the black-ash samples A and B referred to were low, and that there was a greater proportion of sulphate in the vat-liquors than in the black-ash itself, and hence an apparent discrepancy. But Mr. Davis does not tell us that the vat-liquors were the production of the particular black-ash in question, and as one who has had practical experience of the subject I would not suppose that such was the case. Perhaps Mr. Davis will enlighten us on the subject. I also noticed a great similarity in the proportion of sulphate to alkali in the vat-liquor before dilution, and before and after causticising, which proportion I should think to be about the general average, but which may be if anything a trifle higher.

Chemists I am sure will agree with me when I say that very great praise is due to Mr. Davis for placing in such a clear and complete form the whole subject of white caustic soda working. His paper forms the most valuable treatise which has ever appeared on the subject.—I am, &c.,

G. A. R.

November 13, 1875.

MANUFACTURE OF WHITE CAUSTIC SODA.

To the Editor of the Chemical News.

SIR,—By the letter of "Black-Ash" I am glad to find some one taking a deep interest in the analyses of the products in the manufacture of white caustic soda.

For the information of "Black-Ash" (CHEM. NEWS, vol. xxxii., p. 238), and others who may be disposed to ask similar questions, I may state once for all that the products, the analyses of which are given in my paper, are not necessarily the outcome of a previous process. For instance, the black-ash was not made from the identical salt-cakes of which I give the analyses, neither was the vat-liquor made from the black-ash balls A, B, C.

If there is any special connection between two or more sets of products it is specially stated in my paper. I could not do more than this: I have stated that A and B were good balls, and C a bad or burnt one; and although C is given as an example of a bad ball, it is not because there happens to be 3·037 per cent, but because there is also associated with it 6·645 per cent of sodium sulphide.

The average sulphate generally left undecomposed in hand-furnace balls is about 1·5 per cent on the weight of the black-ash taken for analysis. Several paragraphs before the analyses of A, B, and C there will be found two estimations of the sulphate taken from balls on the ball-bank; there the sulphate is 1·2 per cent and 1·7 per cent, and it is there stated that "each experiment is the average of seventy-two balls."—I am, &c.,

GEORGE E. DAVIS.

St. Helens, Lancashire,
November 15, 1875.

SUGAR ANALYSIS.

To the Editor of the Chemical News.

SIR,—Allow me space in your valuable journal for the following lines:—Would any of your readers be kind enough to inform me about an exhaustive work on sugar manufacture from cane, wherein special attention is given to laboratory manipulations, especially the analysis of raw sugar. At the same time I should be much pleased to be informed of such works in the French language.—I am, &c.,

P. H.

Shepton Mallet, November 9, 1875.

MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—As one or two of the letters on this subject have, I fear, tended to create an impression amongst consumers that sulphate of ammonia cannot, with any certainty, be bought free from "sulphocyanide," allow me to state that one of the largest producers of the article (the party referred to in my letter of October 15th) has, since the discussion commenced in your columns, inserted in all his sale notes the following words:—"Guaranteed free from sulphocyanide."

If buyers, who have hitherto strained at the gnat of "colour" and swallowed the camel of sulphocyanide, would now in all cases include these words in their offers, they would have the remedy for the evil in their own hands. I may add for their information that the test for sulphocyanide is so simple that anybody, chemist or non-chemist, may perform it for himself:—A drop or two of perchloride of iron added to a portion of the dissolved sulphate will at once turn it red if sulphocyanide be present.—I am, &c.,

ONWARD.

November 17, 1875.

CRYSTALLOGRAPHY.

To the Editor of the Chemical News.

SIR,—I am not quite sure that I understand Mr. Readwin's query in the CHEMICAL NEWS (vol. xxxii., p. 225), *i.e.*, whether he requires information as to complete and perfect crystals occurring in the forms mentioned, or only as to *observed planes* of those forms.

If the former be the proper interpretation of his query I fear I can give him very little information, since simple and perfect anorthic crystals do not often come under my notice; but one may very often see good planes of the *doubly-oblique rhombic* and *doubly-oblique rectangular* prisms in both natural and artificial crystals of blue vitriol. Mitchell (Orr's "Circle of the Sciences") states that Babingtonite, Christianite, and Sassoline (as well as blue vitriol) exhibit planes of the "doubly-oblique rectangular prism;" blue vitriol, Christianite, and Sassoline of the "doubly-oblique rhombic prism;" Christianite and Sassoline of the "doubly-oblique rhombic pyramid" (and "spheroid"); blue vitriol, Sassoline, Christianite, and Babingtonite of the "doubly-oblique rectangular pyramid" (and "spheroid"). The new crystals of chalkosiderite from Cornwall, described by Professor Maskelyne, exhibit planes parallel to the "doubly-oblique rhombic prisms," the "doubly-oblique rectangular prisms," and the "doubly-oblique rectangular pyramid."—I am, &c.,

J. H. COLLINS.

Truro, November 10, 1875.

CHEMICAL NOMENCLATURE.

To the Editor of the Chemical News.

SIR,—In the opening address of the President of the Chemical Section of the British Association, at its late meeting, regret was expressed at the small number of chemical students in this country as compared with Germany and other Continental nations. May not this arise from the appalling system of nomenclature given to organic substances? A would-be student takes up a work on organic chemistry, and meeting with such words as selen-cyan-ethylen and paramido-ortho-sulpho-toluolic acid (I select at random from the CHEMICAL NEWS) is deterred from proceeding further in the study of a science in which such crack-jaw names are to be found. Could not a more simple system of nomenclature be found? Another drawback appears to me to be the absence of any modern work on the classification of organic substances—I mean a work something on the plan of Dr. Gregory's "Outlines of Chemistry," published some thirty years ago. I beg to submit these two suggestions to the consideration of those

who are better able to pronounce judgment on the subject than myself.—I am, &c.,

An Amateur.

November 15, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 17, October 26, 1875.

New Spectro-Electric Tube (Modification of the Fulgurator).—MM. B. Delachanal and A. Mermet.—This tube is said to possess the following advantages:—Fixity of the spark, permitting a prolonged observation of the spectra; suppression of the meniscus, and consequently of the absorptions which it produces, and which partially hide the spark; removal of the electrodes into a special tube, which preserves the instrument from corrosive projections; possibility of collecting the total of the substance examined; possibility of forming a collection of spectroscopic tubes, containing permanently the solutions of various substances, and allowing of rapid demonstrations and comparisons. The description of the instrument would be unintelligible without the accompanying illustration.

Laws which Govern Reactions of Direct Addition.—M. Markovnikoff.—In this note the author gives further illustrations which fall under the first part of the law as stated in his last paper.

The Nitrate of Soda Trade of South America.—M. V. L'Olivier.—The nitre beds were discovered in 1821 by Mariano de Rivero, but were not worked till ten years later. The nitre forms irregular masses, alternating with beds of common salt and borate of lime, at the height of about 1000 metres, and extending from 19° to 23½° south latitude. The formation is probably due to the evaporation of salt lakes. The thickness of the nitre varies from 0·3 to 2 metres. It is generally covered by a harder saline deposit, known as the *costra*, containing a much lower percentage of nitrate of soda. The composition of a sample of nitre from the basin of the Loa was—

Nitrate of soda	51·50
Sulphate of soda	8·99
Chloride of sodium	22·08
Chloride of potassium	8·55
Chloride of magnesium	0·43
Carbonate of lime	0·12
Silica and oxide of iron	0·90
Iodide of sodium	sometimes traces
Insoluble matter	6·00

A sample of the "Costra" contained—

Nitrate of soda	18·60
Sulphate of soda	16·64
Chloride of sodium	33·80
Chloride of potassium	2·44
Chloride of magnesium	1·62
Carbonate of lime	0·09
Silica and oxide of iron	3·00
Insoluble matter	20 10

Some samples of nitre contain, however, 60 to 70 per cent of nitrate of soda, and it is even sometimes found pure and crystalline. The export duties which the Peruvian Government has laid upon nitrate of soda—to prevent it competing with guano—will soon restrict the trade to the valley of the Loa, in Bolivia.

Experiments made on Geissler Tubes with the Nitrate of Silver Battery already described.—MM. Warren de la Rue and H. V. Müller.—The authors describe four photographic proofs illustrating their experimental results.

Spiral Nebulæ.—M. G. Planté.—The author remarks that if spectrum analysis has latterly enabled us to study the chemical composition of the heavenly bodies, it is not rash to seek to give account of their physical constitution by the observation of electric phenomena. He points out the close resemblance of the spiral nebulæ, as described by Lord Rosse with the result of an experiment in which a cloud of metallic matter, torn away from an electrode by the electric current, takes in the midst of a liquid a gyratory spiral movement under the influence of a magnet.

Moniteur Scientifique, du Dr. Quesneville, November, 1875.

Ferments and Fermentations.—M. Ch. Blondeau.—From this lengthy treatise we extract the following passages:—During the flowering of certain plants we observe an elevation of temperature, accompanied by a disengagement of carbonic acid, which has led certain authors to say that at this part of their existence plants respire in the same manner as animals. In fact, at this period the sugar stored up in the plants undergoes the alcoholic fermentation, and the alcohol formed is burnt, and in burning produces the heat needful for reproduction. When a fruit—*e.g.*, an apple or a pear—has reached maturity, and after being detached from the tree is placed in a vessel of lime-water, the turbidity which appears in the water proves that a development of carbonic acid is taking place. If the fruit, which has thus lived for some time in the absence of air, is submitted to distillation, a notable quantity of alcohol may be obtained, as shown by MM. Lechartier and Bellamy in their researches on the ripening of fruits. Even the simplest vegetables—algæ, lichens, and fungi—contain, during all the course of their existence, alcohol pre-formed, the combustion of which serves to maintain the heat needful for their existence.

Refutation of the Prejudices of Certain Demi-Chemists concerning Salicylic Acid.—M. H. Kolbe.

Antiseptic Effects of Salicylic and Benzoic Acids in the Fermentation of Beer and in Urine.—E. von Meyer and Kolbe.

Use of Salicylic Acid for the Preservation of Milk.—M. A. Pourian.—The nature of these three papers can be sufficiently understood from their titles.

Use of Salicylic Acid in Titration.—Dr. H. Weiske—In determining nitrogen by the method of Varrentrapp and Will, the author uses salicylic acid instead of litmus in the final titration. He dissolves any quantity of salicylic acid in distilled water, separates by filtration any insoluble residue which may remain, and adds to the clear liquid a few drops of a solution of perchloride of iron. Then by means of a burette he pours into the deeply coloured solution a few drops of a very dilute soda-lye till it is exactly neutral, when it takes a yellowish red colour. He then adds to the acid to be titrated a few c.c. of this liquid, which does not take any colour at the commencement, but in proportion as the titration with standard soda is carried on, and the liquid approaches neutrality, a violet colour becomes more manifest. At the moment when neutralisation is on the point of being reached the colour presents its greatest intensity, then as soon as the slightest excess of soda is added it disappears suddenly.—*Journal fur Praktische Chemie.*

Chemical Nature of Salylic Acid.—H. Kolbe.—Salylic acid is merely benzoic acid contaminated with a very small amount of a foreign body not yet determined.

Complete Separation of Arsenic from Animal Matters, and on its Determination in Various Tissues.—M. Armand Gautier.—Already noticed in the *Comptes Rendus.*

Preparation of Tungsten: Composition and Analysis of Wolfram.—M. Ferdinand Jean.—The analysis of wolfram presents some difficulties: the attack

of the ore by *aqua regia* is very slow, often incomplete, and the tungstic acid separated is impure. If the ore is fused with alkaline carbonates it is almost impossible to obtain an integral disaggregation, and the ultimate separation of the tungstic acid, the alkalies, and the silica can only be effected accurately by precipitating the tungstic acid with proto-nitrate of mercury, which very much complicates the analysis. The operation may be effected exactly by mixing intimately 1 grm. of the wolfram to be examined with 0·5 grm. of pure carbonate of lime, and 0·5 grm. of fused chloride of sodium, and igniting the whole for half an hour in a platinum boat, kept in an atmosphere of pure dry nitrogen. After ignition the mixture is treated in heat with hydrochloric acid, which separates out tungstic acid in an insoluble state, and dissolves the oxides of iron and of manganese, lime, &c. It is diluted with water and filtered. In one part of the filtered liquid peroxide of iron is titrated with protochlorides of copper and tin (*Moniteur Scientifique*, June, 1875); then in the rest of the liquid, which is oxidised with chlorates of potash, the whole of the iron is thrown down as hydrated peroxide by boiling with acetate of soda. The solution, freed from the iron, is mixed with sulphide of ammonium, and deposits the manganese as sulphide, which is converted by the action of nitric acid and by ignition into red oxide, and weighed as such. By evaporating the filtrates—in which, if needful, the lime and magnesia may be determined—we separate out a part of the silica which has been dissolved since the attack by hydrochloric acid, and collect in on a filter. With ores containing silica the tungstic acid obtained must not be weighed directly, since it always retains a little silica. It is necessary, in this case, to wash the tungstic acid upon a filter with water containing its own volume of ammonia at 22° until all is dissolved. If the ammoniacal solution of tungstate of ammonia is set aside for five to six hours the silica is completely deposited. It is collected upon the filter already containing the silica obtained by the evaporation of the acid liquors, and the whole is ignited. The solution of tungstate of ammonia, freed from silica, is then evaporated to dryness, and the residue of the evaporation is treated with nitric acid, and then ignited, when pure tungstic acid remains, and may be weighed. In those operations where the object is merely to find the percentage of tungstic acid in the wolfram, the sample may be ignited with soda-lime in contact with the air, for the decomposition in an atmosphere of nitrogen serves merely to enable the amount of ferric oxide to be determined.

Central-Blatt für Agrikultur Chemie,
Heft 9, September, 1875.

Chemical Composition of the Löss Formation.—Dr. A. Hiller and L. Mutschler.—

	Soluble in Hydrochloric Acid 31·218.	Insoluble in Hydrochloric Acid 68·182.
Lime	6·263	0·8750
Magnesia	1·549	0·1120
Carbonic acid	6·020	—
Potash	0·441	1·4390
Soda	0·327	0·9380
Lithion	—	0·0074
Chlorine	0·032	—
Ferric oxide	3·723	1·5490
Alumina	2·915	9·1580
Silica	6·852	55·2860
Phosphoric acid (hydrated)	0·978	—
Water	2·649	—
	30·849	69·3644

The agricultural value of the Löss soils is very high.

Experiments on the Application of Chemical Manures in the Cultivation of Potatoes and Corn.—Eugen Risler.—Taken from the *Journal d'Agriculture Pratique*, 1875, vol. i., No. 10, p. 311.

Knowledge of Milk.—Al. Schmidt.—If milk is freed from diffusible matters (sugar, salts, &c.) casein is separated in the dialyser, along with a trace of phosphate of lime, as a fine precipitate, which re-dissolves neither in soda-lye and acetic acid, nor in the concentrated diffusate of the milk, and has therefore undergone a change.

Results of Food for Sheep.—O. von Reden-Franzburg.

Temperature which Plants Assume in Sunshine.—Dr. E. Askenasy.—On July 15, 3 p.m., the thermometer indicated 31° in the shade:—

Sempervivum alpinum	49·3°	internal, 49·0°.
,, arenarium	48·0°	,, 48·7°.
,, soboliferum	43·7°	,,

Another Sempervivum—

51·2 .. internally, 48·7°.

Obretias and gentianas indicated a much lower temperature.

Chemico-Physiological Researches on the Nutrition of Plants.—Prof. W. Knop and Dr. Hugo Dworzak.—An interesting paper, but not suitable for abstraction.

Investigations on the Sap Issuing in Spring from Recently Pruned Vines, and on the so-called Bleeding of the Vine.—Prof. C. Neubauer and Dr. von Canstein.

MISCELLANEOUS.

University of London.—(*Second B.Sc. Examination* 1875).—*Pass List.* First Division. S. H. Carrington, Owens College; J. E. Clark, B.A., private study; G. Gates, B.A., private study; F. Gotch, B.A., University College; J. E. Harris, B.A., private study; J. V. Jones, University College; J. M. H. Munro, Royal College of Science, Dublin; C. M. Thompson, University College; S. P. Thompson, B.A., Royal School of Mines. Second Division. J. W. Buck, private study; R. Capron, B.A., private study; F. A. Cooper, Owens and University Colleges; F. J. Gladman, B.A., private study; T. F. Harris, private study; O. J. Lodge, University College; W. Saise, Royal School of Mines; A. J. Smith, Owens College; G. Smith, Royal School of Mines; T. S. Tait, St. John's College, Cambridge; H. D. Waugh, B.A., University College.

Dyeing and Calico Printing.—Messrs. Palmer and Howe, of this city, have in preparation a work of considerable importance to manufacturers. It is a treatise on "Dyeing and Calico Printing," by the late Dr. F. Crace-Calvert, F.R.S., F.C.S. It will include a short account of the most recent improvements in the manufacture and use of aniline colours, and is being prepared under the editorial care of John Stenhouse, LL.D., F.R.S., and Charles Edward Groves, F.C.S. The publishers have already disposed of an edition for the American market.—*Manchester Guardian.*

The Iron and Steel Institute—Supplementary Meeting.—In consequence of the time at the Manchester Meeting being insufficient to allow of the reading and discussion of several papers that were upon the programme, it has been decided to hold a Supplementary General Meeting in London, on Thursday, November 25. By the kind permission of the Council of the Institution of Civil Engineers, this meeting will be held in the rooms of that Society, 25, Great George Street, Westminster, London, S.W., at 10.30 a.m. The following is the programme:—Adjourned discussion on Mr. Adamson's paper on "High Pressure Steam Generally, and its Application to Quadruple Engines;" discussion on Mr. I. Lowthian Bell's paper on "Price's Patent Retort Furnace;" paper by Mr. G. J. Snelus on "Fire-clay and other Refractory Materials;" paper by Mr. William Hackney on the "Manufacture of Anthracite Coke in South Wales;" paper by Mr. C. J. Homer on the "North Staffordshire Coal-field, with the Ironstones contained therein."

THE CHEMICAL NEWS.

Vol. XXXII. No. 835.

CHEMISTRY IN SWANSEA.

We have repeatedly insisted on the necessity of a thorough organisation for analytical chemists, both for the sake of raising and securing the *status* of the profession, and of excluding all improper and unqualified persons. Indeed, these two objects are practically identical. So long as any person, competent or otherwise, can call himself an "analytical and consulting chemist," and can practise as such, so long the *bonâ fide* members of the profession will be deprived both of the consideration and the emoluments to which they are justly entitled. An event—we might say a scandal—which has happened at Swansea gives the fullest confirmation to our remarks. We have hitherto refrained from commenting upon this case in the hope that the gentleman whose professional character is at stake would have been able to offer some explanation of the circumstances. Indeed, so extraordinary are the details, that save for the fact that the Principality is not prone to jesting, we should have received the whole affair as a hoax. As, however, neither contradiction nor explanation appears we are compelled to accept the case as real, and to deal with it as such.

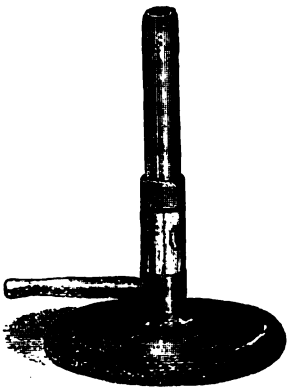
At the Glamorganshire Quarter Sessions a man was charged with stealing a gallon of oil. The point turning on the identity of the oil found in his possession with that supposed to have been stolen, the prosecution called "W. Morgan, Ph.D., F.C.S., analytical chemist and public analyst for the Borough of Swansea," who "produced certain samples of oil, which, he said, were all a mixture of rape-seed oil and a little train oil, only differing in degree as to proportion. There was a little Gallipoli oil in one of the samples. The Chairman: What is train oil? Witness: I don't know. Chairman: Is it a vegetable oil or a mineral oil? Witness: A vegetable oil. Chairman: In what proportion does the train oil exist in the four samples? Witness: I don't know. Chairman: What are the constituent parts of train oil? Witness: I don't know. Chairman: Cannot you tell in what proportion the train oil exists in the samples you have produced? Witness: No, I cannot. No living man can tell. (Taking a book from his pocket, and looking into it.) I wish to correct myself. I find here that train oil is taken from the whale. Chairman: Then it is not a vegetable oil? Witness: No, a mineral. The witness was closely cross-questioned by Mr. Dunn, and stated that he knew all along that train oil was a mineral oil, but he got confused. He did not know that the Esquimaux were fond of train oil, but he knew that the component parts of the oil were carbon, hydrogen, and oxygen."

We are utterly at a loss to comprehend this extraordinary evidence. Leaving out of the question all chemists, analytical or pharmaceutical, all drysalters, oilmen, and the like, we should have believed that every schoolboy knew that train oil is the product of the whale, and that whales are not "minerals." The fact of a member of a learned profession, a University graduate, and Fellow of a scientific society having to consult a book to ascertain the nature of so common a substance is so humiliating that all comment is an anti-climax. But the bearings of the matter cannot be thus briefly dismissed, and must be viewed by all friends of science with painful concern. The "Adulterators' Organ" is evidently in high glee, which will doubtless be shared by those unscientific Members of Parliament who have kindly taken upon themselves to adjudicate on the "competence" of chemists, and whose absurd charges will receive from this incident at least a colour of truth. But from the bodies who are, more or less, gravely compromised by Mr. Morgan's self-exposure, we must expect not merely thought, but action. The gentleman in question must be assumed, until we have proof to the contrary, to be a graduate of some German university. Now such ignorance as he has displayed might have been conceivable in an Oxonian of the old school, who complacently overlooked all knowledge not contained in the classics. But the normal German "Gelehrte" is no less distinguished for the wide compass than the minute accuracy of his learning, and for Berlin or Giessen, Göttingen or Bonn, Heidelberg or Leipzig to have turned out such a graduate is exceptional almost beyond belief. Whatever university has the honour of being his *Alma Mater* would do well to exercise for the future a judicious caution in granting degrees. Not less must the Chemical Society look to the matter, and consider whether its Fellowship is not sometimes bestowed too lightly. If such scandals as this recur the letters F.C.S. may not be highly coveted by men conscious of their own standing. In former days men were judged by their degrees and diplomas. Now they must be estimated rather by their researches and writings. Dare we add that perhaps degrees and diplomas may come, before long, to be judged according to the personal merit of their holders?

A NON-RETREATING BUNSEN BURNER.

By President HENRY MORTON, Ph.D.
Stevens Institute of Technology, Hoboken, N.J.

In consequence of the low pressure of gas during the daytime, in this place, we have long experienced trouble from the retreating Bunsen burners of the usual construction. This having repeatedly proved a source of annoyance and loss, I was led to a series of experiments with the view of removing the difficulty, if possible, by some modification in the form of the burner.



After various trials with burners, in which the relation of height to diameter in the main tube and of the size of the gas-jet were varied, I was led to the following consideration of the subject:—

The retreat of a burner will evidently occur whenever any part of the ascending column of mixed gas and air is moving at the orifice with a velocity less than that at which the same will burn downwards. Now, in an ordinary burner, with its main tube of regular cylindrical bore, it is evident that the friction of the surface of the ascending column of mixed gases will cause that portion to move at a less velocity than the central part, and that currents of the nature of eddies will be developed.

It will thus happen that while the central portion of the ascending column of gaseous mixture issues at a velocity much greater than that at which the material can burn downwards, and thus is quite free from any danger of retreating, the marginal portions of the column or jet of gas will be escaping at a rate so much less that the velocity of their combustion downwards will exceed that of their upward motion, and retreat of the flame will ensue.

It is well known that to secure a jet of water, or of any other fluid whose particles shall move with equal velocities in all parts, and thus avoid currents and eddies, it is only necessary to make the orifice of efflux an aperture in a thin wall.

Following out the idea above indicated, I made a burner of a bore rather large compared with its height, and then drew in its upper edge into the form of an open-ended thimble, so contracting the orifice of escape to about two-thirds the area of the tube, and rendering this orifice practically an opening in a thin horizontal wall or plate.

The results of this modification far surpassed my anticipations. A burner thus constructed gives a perfectly non-luminous flame with gas pressures varying between 1·5 and 0·1 inch of water, and with the lowest of these pressures cannot be made to retreat by the most violent handling in the way of sudden movement or waving about in the air, even when this violence is carried to the extent of extinguishing the flame altogether.

Under like conditions of pressure, a burner of the ordinary construction is made to retreat by a slight draught of air, or a very moderate amount of motion.

These burners have been constructed in quantities for our use and for other colleges by Messrs. Geo. Wale and Co. of this place.

A DERIVATIVE OF THE HYDROCARBON, VALERYLENE.

By P. HAUBST, Ph.D.

As is well known, the non-saturated hydrocarbons possess the property of combining with hypochlorous acid by direct addition to form chlorinated hydric alcohols, convertible into the corresponding alcohols by appropriate chemical reactions.

In order to show this in the case of the hydrocarbon valerylene, first obtained by Reboul, I prepared a sufficient quantity of this substance from amylene, obtained by heating zincic chloride with amylic alcohol (fusel oil), and caused it to be acted upon by hypochlorous acid. The compound thus formed was extracted by ether, and, the latter being distilled, a brown-red liquid remained.

Expt. 1.—10 grms. valerylen yielded 15·0 grms. product.
Expt. 2.—10 „ „ „ 15·2 „ „

A sample of the new product was submitted to distillation. At 90° C., the liquid assumed an intensely dark colour; the temperature being increased, a liquid of an highly irritating odour distilled over, while at the same time hydrochloric vapours were evolved. At 140° C., a total decomposition took place, and a black syrupy mass was left in the residue.

To ascertain the atomical composition, a sufficient quantity of the original product was dried and submitted to elementary analysis.

The chlorine was determined according to the method devised by Professor Carius, in sealed glass tubes at a high temperature.

Expt. 1.—0·1610 grm. yielded 0·0463 grm. Cl, or 28·72 p. ct.
Expt. 2.—0·1718 „ „ 0·0488 „ „ 28·28 „

Carbon and hydrogen were determined by means of combustion with plumbic chromate, with the following results:—

Expt. 1.—39·23 per cent carbon, 5·94 per cent hydrogen.
Expt. 2.—39·38 „ „ 5·82 „ „
Expt. 3.—38·91 „ „ 6·04 „ „

If we take the average of these numbers, and calculate, as usual, the oxygen from the loss, the following results are obtained:—

C = 39·24
H = 5·93
Cl = 28·53
O = 26·30

If we divide by the corresponding atomic weights and take the chlorine as unit, we have the formula $C_4H_7ClO_2$.

The different behaviour of valerylene to hypochlorous acid must be accounted for by its different molecular structure. As it was mentioned, the valerylene used in our researches was prepared from an isoamylene; the latter kind of hydrocarbons generally split up when acted upon by energetic reagents.

That new body, empirically of the same composition as monochlor-butyric acid, has a sp. gr. of 1·065 at 15° C., is of a strongly acid character, and reduces silver salts to metallic silver. It has a highly penetrating odour, and burns with a green-edged flame.

On adding water and ammonia, a clear solution is obtained; argentic nitrate does not precipitate the chlorine, but, after evaporating to dryness and re-dissolving, chlorine is eliminated. The salts obtained with baric, calcic, and plumbic carbonates or hydrates bear the same character. Thus, it seems, this body has not the property of forming distinctly characterised salts.

Shepton Mallet, November 16, 1875.

INCRUSTATION ON AN OLD FLUE.

By J. W. CHALMERS HARVEY.

On opening an underground flue, 5 feet high and 3½ wide, by which the fires from a range of large boilers communicated with a high chimney, an incrustation was found on the roof and walls, covering an extent of upwards of 50 feet, and varying in thickness from ¼ of an inch to nearly 1 inch in some places, the thickest parts forming a ridge exactly over the joinings of the bricks where the mortar had been exposed to the action of the gases. In fact every joint stood out in such a way as to mark distinctly the form of each brick that had been used in lining the flue. The flue had been in constant use for about five years, and the boilers were fired with the Cumberland coal of the neighbourhood, which is a caking coal, and contains on an average about 2 per cent of sulphur. The following is an analysis of the substance dried at 212° F.:—

	Per Cent.
Insoluble matter	23·39
Ferric oxide	2·91
Alumina	6·10
Lime	11·31
Magnesia	0·55
Sulphuric anhydride	38·14
Potash	6·47
Soda	0·52
Water	11·40
	100·79

It appears from the above analysis that a very considerable proportion, if not the whole, of the sulphur dioxide first formed from the sulphur in the coal has been further oxidised into sulphuric acid before it reached the chimney, and acting upon the bases of which the lining of the flue is composed converted them into sulphates. It seems also clear that the potash has been volatilised from the coal, as it is highly improbable that it owes its origin to the materials used in the construction of the flue.

In densely-populated manufacturing towns if mortar was freely used in covering the interior of flues, or lime placed in some convenient part of them, where it could be replenished from time to time, might it not be attended with beneficial sanitary results? as it would retain much of the sulphur dioxide that would otherwise escape into the atmosphere.

My thanks are due to Mr. Noble, at whose suggestion I undertook the analysis.

Chemical Laboratory of the Maryport Hematite Iron Works, November 12, 1875.

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ZETTNOW'S SCHEME FOR QUALITATIVE ANALYSIS WITHOUT THE USE OF H_2S OR $(NH_4)HS$

Arranged by H. CARRINGTON BOLTON, Ph.D.,
For the Students of the School of Mines, Columbia College.

Add hydrochloric acid to the solution, wash, and filter.

Precipitate. Boil with water and filter.

Filtrate. Add excess of dilute H_2SO_4 and wash on filter.

Solution. Add H_2SO_4.

Precipitate. Pb.

Residue. Treat with $(NH_4)HO$.

Solution. Add HNO_3.

Precipitate. Ag.

Residue turns grey or black. Hg.

Precipitate. Agitate with considerable cold water and filter.

Filtrate. Add excess of $(NH_4)_2C_2O_4$.

Precipitate. Ca.

Residue. Add $(NH_4)HO$ and $(NH_4)_2C_4H_4O_6$, digest and filter.

Residue. Boil with Na_2CO_3, filter, wash, dissolve on filter with HCl, neutralise filtrate with $(NH_4)HO$, and divide into two parts.

First Half. Add excess of solution of $SrSO_4$.

Precipitate. Ba.

Second Half. Add excess of $H_2Si_2Fl_6$ and alcohol. Shake, filter, dilute with water, expel alcohol by evaporation, add solution of $CaSO_4$, and after one or two minutes a precipitate Sr.

Filtrate. Add $H(C_2H_3O_2)$ and K_2CrO_4.

Precipitate. Pb.

Filtrate. Divide the solution into two unequal parts, ¼ and ¾.

To ¼ add BaH_2O_2 and boil.

Volatilised $(NH_4)_2O$. Test gas with HCl and litmus.

Solution. Add excess of $(NH_4)_2CO_3$ and $(NH_4)_2C_2O_4$ warm, filter, evaporate to dryness, and ignite residue. Test on platinum wire in colourless flame; intense yellow colour indicates Na. Violet colour seen through blue glass indicates K.

Place ¾ of the solution in a Marsh's apparatus, add pieces of zinc and a strip of platinum foil, when but little zinc remains heat 15 or 20 minutes, and throw contents of flask on a filter; wash thoroughly.

Volatilised. Collect spots on cold porcelain, and treat with NaClO. Spots dissolve; As spots do not dissolve; Sb Test also with $AgNO_3$

Residue. Treat with strong HNO_3, and filter.

Residue. Wash, boil with HCl, and filter.

Solution. Put in a platinum dish with a piece of zinc. A dark spot on the platinum indicates Sb.

Residue. Add to solution in platinum dish, boil with HCl, filter, and add $HgCl_2$.

Precipitate. Sn.

Filtrate. Divide into two parts.

1st Half. Add $SnCl_2$.

Precipitate. Hg.

Second Half. Add HCl, boil, then add excess of NaHO, wash the precipitate on filter with water, then with $(NH_4)HO$ containing NH_4Cl.

Residue. Dissolve on filter in very little HCl, and add large quantity of H_2O to the filtrate. A cloudy precipitate indicates Bi.

Filtrate. Divide into two parts.

1st Half. Acidify with HCl and add $K_4Fe_2Cy_6$.

Precipitate. Cu.

2nd Half. Add excess of NaHO, a white gelatinous **Precipitate,** Cd.

Filtrate. Boil with a little HNO_3, and divide in two unequal parts.

First Portion. Add KCyS. *Red Colour.* Fe.*

Second Portion. Neutralise with $(NH_4)HO$, add excess of $BaCO_3$, agitate ten minutes, filter, and wash thoroughly.

Precipitate. Boil in a porcelain dish with dilute H_2SO_4, and filter. Add excess of NaHO to filtrate, a few drops of $KMnO_4$, and a little NH_4Cl. Boil, filter, and divide the solution.

1st Half. Add some $H(C_2H_3O_2)$ and $Pb(C_2H_3O_2)_2$ *Precipitate.* Cr.

2d Half. Add excess of NH_4Cl. *Precipitate.* Al.

Filtrate. Add excess of dilute H_2SO_4, filter, and saturate filtrate with $(NH_4)_2CO_3$; warm, filter, and wash.

Precipitate. Mix a portion with Na_2CO_3 and $NaNO_3$; fuse on platinum foil. *Green Colour.* Mn.

Dissolve another portion in HCl, neutralise with $(NH_4)HO$, add considerable NH_4Cl and $(NH_4)_2C_2O_4$ **Precipitate.** Ca.

Solution. Add Na_2HPO_4.

Precipitate. Mg.

Solution. Evaporate to dryness, dissolve in HCl, add KNO_3 and $H(C_2H_3O_2)$, filter.

Precipitate. Co.

Solution. Add NaHO

Precipitate. Ni.

* To determine degree of oxidation of Fe, examine the original solution with $K_4Fe_2Cy_6$ and KCyS.

N.B.—To test for zinc, mix a portion of the original solution with HCl, H_2SO_4, filter, add NaHO in excess, and boil. Add a little $(NH_4)_2CO_3$ and NH_4Cl to filtrate, boil until all odour of $(NH_4)HO$ is expelled, and filter. Add $K_4Fe_2Cy_6$ to solution; a cloud or precipitate indicates Zn.

In this scheme regard is had to the following substances in aqueous solution:—

I. PbO, Ag_2O, HgO.
II. CaO, BaO, SrO.
III. $(NH_4)_2O$, Na_2O, K_2O.
IV. As_2O_3, As_2O_5, Sb_2O_3, Sb_2O_5, SnO, SnO_2, Hg_2O, CuO, CdO, Bi_2O_3.
V. FeO, Fe_2O_3, Cr_2O_3, Al_2O_3.
VI. MnO, MgO, CoO, NiO.
VII. ZnO.

Chemical News, Nov. 26, 1875.

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ALIZARIN FROM ANTHRACEN-SULPHO-ACID.

By G. AUERBACH.

II.

In my last paper I said I believed it to be theoretically impossible to produce alizarin from anthracen-sulpho-acid, because the anthracen-sulpho-acid does not give anthraquinon by oxidising, but a sulpho-acid isomeric with anthraquinon-sulpho-acid.

The following experiment will further prove my theory that anthracen-sulpho-acid cannot produce alizarin:—

I tried to prepare anthraquinon-sulpho-acid from bichlor-anthracen-sulpho-acid. First, I converted anthracen into anthracen-sulpho-acid, and heated this body with chlorine: the temperature rose to 170° C. without heating it. The sulpho-acid was heated with an excess of chlorine, and then, to form anthraquinon-sulpho-acid, was heated with an excess of sulphuric acid at a temperature of 220° C. It forms a brown-red sulpho-acid, sulphurous acid and hydrochloric acid being given off, and a black insoluble residue, which is always obtained in the preparation of anthraquinon-sulpho-acid from bichlor-anthracen, which is not perfectly pure. The sulpho-acid salt obtained is red, like the soda salt of the common anthraquinon-disulpho-acid. By melting this with soda a violet melt is obtained, which, when precipitated by an acid, does not give any alizarin nor any trace of colour.

If the sulphuric acid had another place in the anthracen-sulpho-acid than the chlorine in the bichlor-anthracen, then the chlorine must have the place of the oxygen in the quinon. If this had been the case I ought to have obtained the common soda salt of the anthraquinon-disulpho-acid, and from this salt alizarin. But I did not get alizarin, which proves the sulphuric acid in the anthracen-disulpho-acid has the same position as the chlorine in the bichlor-anthracen. But the sulphuric acid in the anthracen-disulpho-acid is linked, and cannot be substituted by the quinone-oxygen, and, therefore, if it is substituted by hydroxyls, one obtains a body isomeric with alizarin but not identical.

Greenford Green, Harrow,
Middlesex.

ON PYROLOGY, OR ANALYSIS AND SYNTHESIS BY MEANS OF THE BLOWPIPE.

By W. A. ROSS.

(1). It is almost amusing to hear the ideas which the English people generally entertain regarding the blowpipe and its use. A considerable number have evidently never heard of such a thing at all. The immense majority conceive, or possibly know, it to be an implement used by goldsmiths, tin-smiths, and gas-fitters, but, if asked suddenly, could not say whether it might not be useful to some other people as well. Even among the select few who appreciate the utility of this instrument in England, that is circumscribed (as will be evident from the perusal of any of our works on chemistry or mineralogy) to a means of identication or confirmation, rather than of analysis.

(2). Now the fact certainly is—although I am not prepared to say that any of us yet understand the art sufficiently to prove it in all details—that, when this science and its results are collated with the careful use of the microscope and the assay balance, a method of analysis has been attained which yields to no human one, not even that by the spectroscope, in minuteness combined with exactness.

(3). It is true that the best operator with the blowpipe can by no means, as yet, perform anything like an analogous process to the beautiful, and, it may be presumed, nearly perfect, system of *separation* of substances obtained in watered solution, by the aid of the violent acids and alkalies, which constitutes the noble science called modern analytical chemistry; but, on the other hand, it will be evident to the warmest, if yet candid, chemist, that the most delicate of his analytical methods must give place to those obtainable by means of the blowpipe, if used with due intelligence. And it must be remembered that the former science, inaugurated (as to its due importance) by Scheele, Klaproth, Berzelius, Davy, and brought to such perfection by the present generation of analysts, dates, in reality, from about the time of Paracelsus;* while that of blowpipe analysis, degraded into a confirmatory testing process by the chemist, and into a "fusible or infusible" testing process by the mineralogist, can be scarcely said to have properly commenced; so that we cannot doubt that a similar application to it of such minds as those belonging to the names above mentioned would develop a system of pyrological *separation* equal in delicacy and importance to that of chemical analysis.

(4). Admitting, then, as we must, that analysis and synthesis, by means of the blowpipe, is susceptible of being systematised as a science standing on its own ground, without more, or even as much, assistance from hydracid, or ordinary chemistry, as this requires from that, we find, at starting in such a labour, that the student possesses the enormous advantage of not being perplexed with, and confounded by, the tremendous terminology—the dinitroxanthracenes or tetra-methyl-anthracenes, &c.—which the study of chemistry nowadays entails. Fortunately, also, no one has yet suggested the application of the doctrines of equivalence and atomicity to the work of the blowpipe, which may, therefore, be looked upon as an essentially *practical* and thoroughly *simple* science, which, notwithstanding its evident importance, is, therefore, far from being without the grasp of an ordinarily intelligent comprehension.

(5). Analysis by means of the blowpipe is supposed to be confined to inorganic substances; but, although that of organic matters has certainly, as yet, been scarcely attempted, and only, I believe, by myself, that it is not merely possible, but likely to be really important, will readily be admitted by any operator who, possessing a good microscope, places in the focus of that a *boric acid* bead or glass in which an ordinary healthy house fly has been burned, and alongside of it another bead of the same substance, in which a fly poisoned by an arsenical fly-paper has been consumed. The difference is *so striking* that no physician, worthy of the name, would fail to observe it. Not a scrap the size of a pin's head of our skin, nails, hair, blood, mucus, &c., but shows, when similarly analysed, really considerable traces of inorganic matter, as calcic phosphate, and silica, so that the conclusion almost seems that, although (as chemists relate) the proportion of the latter is infinitesimally small, it is so dispersed in every minute part of the former that this may be almost said to be built up of that. When we consider, then, that scarcely a single one of the innumerable organic substances found in nature, or separated by the chemist, has been thus examined, we at once see what a vast and novel field of this mode of research is open to any physiologist who likes to take it up.

(6). But, as we must be able to walk before we can venture to run, I propose in these pages to give as simple, and yet as little incorrect, account as I can of that invaluable little instrument, the *blowpipe*, of the few reagents required, and of the method of using both; so that it shall not be my fault if the medical, mineralogical, or geological student, the miner, the farmer, or the druggist, fails to avail himself of the important knowledge to be gained from this fascinating, elegant, cheap, rapid, accurate, and almost new method of analysis. As it will not be possible, however, to insert here *figures* of the blowpipe itself and of the few accessory implements necessary, I must refer the English student, for an idea of these, to books on the

* "Philip Aureolus Theophrastus, Paracelsus, Bombast de Hoenheym, was born in the year 1404, in the village of Hoenheym (or high snow), two miles from Zurich."—*Boerhaave*

subject, such as "Berzelius," Children's or Whitney's translation (both of which I have often purchased for a shilling at the old book-stalls in London); "Blanford" and "Scheerer;" "Fuchs;" the excellent American works, as "Elderhorst," "Brush," and Cornwall's translation of Richter's "Plattner;" and my own work, "Pyrology." If any of these books are too expensive for the limited pocket of most students, it must yet be remembered that the processes they describe and implements they figure obviate the necessity of purchasing expensive, fragile, and unportable apparatus and reagents, which, to obtain anything like similar knowledge, is otherwise absolute. These expensive books, also, are (or should be) available for reference at scientific circulating libraries, or, at any rate, at the British Museum.

(To be continued.)

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 242.)

At that time, the power of steering balloons was more than ever felt to be necessary. Many of Montgolfier's contemporaries, including well-known physicists and mathematicians, such as Meusnier, Monge, Lalande, &c., had pronounced this problem to be practicable. Fruitless and partially absurd attempts at its solution were not wanting. The celebrated inventor of the injector, Henry Giffard, was not deterred from carrying out new experiments in this direction in the year 1852, and the most recent attempts are based upon his ideas and those of Meusnier. Instead of the ordinary form, Giffard gave his balloon the fish-like shape of a ship, for the convenience of steering. A steam-engine, with its chimney turned downwards to obviate the risk of fire, and whose steam was simultaneously employed to maintain the draught, turned a screw sufficient to turn the balloon, but certainly too weak to overcome the strong wind which, on September 25th, drove Giffard's aërial ship before it. Public opinion then turned in favour of a project of aërial navigation opposed to all previous methods. Ponton d'Amecourt, De la Landell, and Nadar wished to attempt by mere mechanical force, without the aid of light gases, to navigate the air in all directions. The authority of Babinet supported this scheme, which, however, according to Helmholtz,† had no sound physical basis, and which, when carried into execution, proved a failure.

When the Paris Exhibition of 1867 drew general attention to every industrial advance, Giffard received a commission to make aëronautics available for the "million" by means of a hydrogen balloon. He constructed a balloon of 5000 cubic metres capacity, the inflation of which with hydrogen generated by iron and sulphuric acid in wooden casks cost 5000 francs. The gas was subsequently prepared by him for a twentieth part of the cost of conducting steam over ignited charcoal, a method of which Coutelle had made use in 1794. The balloon was attached to a wire rope 300 metres in length, and was very skilfully secured. A steam-engine of 50-horse power uncoiled the rope, and drew down the balloon with its passengers when the permitted height had been reached. This height was not great enough to occasion any danger from the expansion of the gas, hence Giffard was able to close the balloon with valves instead of leaving it open below. Thus, the loss of gas by diffusion did not exceed 15 cubic metres daily, and was easily replaced at intervals of three days.

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† Helmholtz, *Berl. Akad. Ber. u. Verhand d. Ver. für Gewerbfleiss in Preussen*, 1873, 326.

The next impulse to aëronautics was given, not by festivity, but by the terrors of war and the siege of Paris. The Académie des Sciences commissioned one of its members, Dupuy de Lôme, to make experiments on steering balloons, and the Government furnished the requisite means. Dupuy gave his balloon the fish shape,* and, in order to render its shape stable in the wind, he fitted it with an internal secondary balloon (*ballonet*), containing more or less air, and equal in bulk to one-tenth part of the main balloon. The air could be let out of this inner balloon by valves, or driven in again by means of a bellows in the car, according to a plan which Meusnier had devised as early as 1783 to supersede the use of ballast. Dupuy's balloon was further distinguished by a very firm method of suspending the car, and by the use of a varnish impermeable to gases, and made of gelatin and tannin dissolved in pyroligneous acid. The propelling screw was not turned by a steam-engine, but by eight men in the car. The balloon, containing 3450 cubic metres, was filled with hydrogen obtained from iron and sulphuric acid, and went up at Vincennes on February 1st, 1872, carrying fourteen persons. After a flight of two hours, it was let down at Noyon, a distance of 106 kilometres. By means of an anemometer, Dupuy was able to determine the independent speed of the balloon at 2·82 metres per second, whilst that of the wind was 16 to 17 metres, and the course of the balloon made an angle of 12° with the direction of the wind. The problem of steering had, therefore, been solved, though only to a very slight degree—sufficient for a calm, but insufficient for overcoming even moderate winds. The speed attained was slight. Both conditions of success depend on the employment of stronger sources of mechanical power, and this, again, requires an increase of its power of ascent, *i.e.*, of its relative levity with an enlarged volume.

(To be continued.)

* Dupuy de Lome, "Note sur l'Aërostat." Paris: Gautier-Villars. 1872.

THE CHEMICAL CONSTITUTION OF THE CHLORINATED METHYL & ETHYL ETHERS,
AS ALSO OF THE
CHLORINATED COMBINATIONS OF THESE ETHERS WITH FORMIC, ACETIC, OXALIC, AND CARBONIC ACIDS,

VIEWED AND INTERPRETED FROM THE STANDPOINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

(Concluded from p. 244).

PART II.

On the Principal Molecular Changes attending the Formation and Transformation of that Set of Chemical Compounds which fall under the Second Class of Chloro-Derivatives.

Retaining for the members of this class the familiar term "perchloro-derivatives," we shall have, in the prescribed order of succession:—

A. *The Perchloro-Methyl-Ether*, $2\overline{Fo}Cl_2,2\overline{Fo}Cl_2O_2$.—This compound is directly descended from the penta-chloro-methyl-ether—

$$\overline{\overline{Me}}_2O_2.$$
$$2\overline{Fo}Cl_2O,$$

through the following series of molecular changes:—Two molecules of the ether conspire towards the production of two principal groups. The first of these groups is due to the splitting-up of the detached bases into two molecules of water and two molecules of dichloro-methylen, both of which are speedily made to merge into the isomeric modification of chloro-carbonous acid, $2C_2Cl_2$. Subsequently, one of these molecules becomes oxidised into

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chloro-carbonic acid at the expense of the aforesaid two molecules of water, when the chemical union of the two, now differently modified, acid bicarbon nuclei gives rise to a molecule of dichloroxalic acid, $2C_2Cl_2,2C_2Cl_2O_2$. At the same time, the two liberated hydrogen molecules combine as adjuncts, the one with the anterior, and the other with the posterior, component member of the dichloroxalic acid, with final production of a molecule of dichloroformic acid, $2FoCl_2,2FoCl_2O_2$. It is almost superfluous to add that, in consequence of this typical metamorphosis, the last remaining molecule of hydrogen has now likewise been rendered fit for replacement by chlorine, when the product of its last and greatest substitutional efforts will be a molecule of the perchloro-methyl-ether, as formulated above. The second of these groups is due to certain intra-molecular movements in the detached acids, involving the transfer of a molecule of enveloping oxygen from one of the two conspiring molecules to the other. In virtue of this characteristic re-arrangement, the two acid bicarbon nuclei have now, with the restoration of evenness in the number of their enveloping univalent molecules, and with the accompanying excess of two molecules of oxygen in one of their envelopes, acquired different electro-polar energies, and, with these, the power of entering into chemical union with one another. The offspring of this union is a second molecule of perchloro-methyl-ether, which claims, therefore, to be regarded as anhydrous trichloro-formic acid.

B. *The Perchloro-Ethyl-Ether*, $\overline{2AcCl_2},\overline{2AcCl_2O_2}$.—This compound is directly descended from the ennea-chlorethyl-ether—

$$\overline{Et_2O_2}.$$
$$\overline{2AcCl_2O},$$

through a series of molecular changes closely analogous to those we have just been considering, the resulting products being on the side of the detached bases, the molecule $\overline{2AcCl_2},\overline{2AcCl_2O_2}$, which, by the interchange of chlorine for hydrogen, gives rise to the perchlorethyl-ether, as formulated above, and, on the side of the detached acids, a second molecule of perchlorethyl-ether, which claims, therefore, to be regarded as anhydrous penta-chloracetic acid.

In turning to the perchloro-derivatives of the formic, acetic, oxalic, and carbonic ethers, it will not be necessary for me to enter into details, since the molecular changes attending their formation are precisely similar to those attending the formation of the two preceding perchloro-derivatives. It will, therefore, be sufficient to draw the reader's attention to the annexed tabular arrangement, where the two sets of perchlorinated ether-salts are given under the heads of their respective perchlorinated ether-bases, two molecules of which are here, for comparison's sake, represented as being condensed into one.

Table of Chemical Formulæ expressing the Chemical Constitution of the Perchlorinated Methyl- and Ethyl-Ethers, as also of the Perchlorinated Combinations of these Ethers with Formic, Acetic, Oxalic, and Carbonic Acids.

A. $(2\overline{FoCl_2},2\overline{FoCl_2O_2}),(2\overline{FoCl_2},2\overline{FoCl_2O_2})$.

A. (1). $(2\overline{FoCl_2},2\overline{FoCl_2O_2}),(2\overline{FoO_2},2\overline{FoO_4})$.

A. (2). $(2\overline{FoCl_2},2\overline{FoCl_2O_2}),(\overline{2AcO_2},\overline{2AcO_4})$.

A. (3). $(2\overline{FoCl_2},2\overline{FoCl_2O_2}),(2C_2O_2,2C_2O_4)$.

A. (4). $(2\overline{FoCl_2},2\overline{FoCl_2O_2}),(2C_2O_4)$.

B. $(\overline{2AcCl_2},\overline{2AcCl_2O_2}),(\overline{2AcCl_2},\overline{2AcCl_2O_2})$.

B. (1). $(\overline{2AcCl_2},\overline{2AcCl_2O_2}),(2\overline{FoO_2},2\overline{FoO_4})$.

B. (2). $(\overline{2AcCl_2},\overline{2AcCl_2O_2}),(\overline{2AcO_2},\overline{2AcO_4})$.

B. (3). $(\overline{2AcCl_2},\overline{2AcCl_2O_2}),(2C_2O_2,2C_2O_4)$.

B. (4). $(\overline{2AcCl_2},\overline{2AcCl_2O_2}),(2C_2O_4)$.

This table shows at a glance that all the perchloro-derivatives agree in being composed of two principal groups, the first of which corresponds to the perchlorinated ether base, and the second to the perchlorinated organic acid. In studying the effects of temperature upon these complex systems, a curious and interesting regularity is brought to light, by means of certain marked and striking intra-molecular changes which the principal groups are mutually superinducing in, or previous to, the act of parting company with each other. This regularity may be briefly described as consisting in the uniform interchange of two molecules of chlorine contained in the envelope of the anterior member of the first principal group for two molecules of oxygen contained in the envelope of the posterior member of the second principal group, the only notable exception to this rule being the perchloro-derivatives of the methylic and ethylic carbonates, where, at least in the ordinary conditions of the experiment, the disunion of the two principal groups is not accompanied by an interchange of chlorine for oxygen.

It is in perfect harmony with our rule, as specified above, that A is observed to split up into a molecule of chloro-formyl-oxychloride (phosgen), $2\overline{FoO_2},2\overline{FoCl_2O_2}$, and a molecule of chloro-formyl-trichloride, $2\overline{FoCl_2},2\overline{FoCl_4} \div \div A$ (1) into two molecules of phosgen $\div A$ (2) into a molecule of phosgen and a molecule of trichloracetyl-oxychloride, $\overline{2AcO_2},\overline{2AcCl_2O_2} \div A$ (3) into a molecule of phosgen and a molecule of oxalyl-oxychloride, $2C_2O_2,2C_2Cl_2O_2$, which, in the existing conditions, is, however, speedily made to resolve itself into carbonic oxide and phosgen $\div B$ into a molecule of trichloracetyl-oxychloride and a molecule of trichloracetyl-trichloride, $\overline{2AcCl_2},\overline{2AcCl_4} \div B$ (1) into a molecule of trichloracetyl-oxychloride and a molecule of phosgen $\div B$ (2) into two molecules of trichloracetyl-oxychloride $\div B$ (3) into a molecule of trichloracetyl-oxychloride and a molecule of oxalyl-oxychloride, which soon resolves itself as above. Turning to the exceptional molecules, A (4) and B (4), their decomposition products by heat are found to be, for the first, carbonic acid, phosgen, and chloro-formyl-trichloride (the two latter being derived from two molecules of previously-formed perchloro-methyl-ether); and, for the second, carbonic acid, trichloracetyl-oxychloride, and trichloracetyl-trichloride (the two latter being derived from two molecules of previously-formed perchlorethyl-ether.)

In connection with this, theoretically, most momentous and instructive subject, I must not omit alluding to an interesting case of isomerism that obtains between the molecules A (2) and B (1). Under the influence of temperature, these compounds are both of them observed to split up into phosgen and trichloracetyl-oxychloride, and to comport themselves towards the ordinary chemical reagents like one and the same substance. Nevertheless, the results of my analyses, as embodied in their respective formulæ, leave no doubt that these two perchloro-derivatives are not chemically identical. They are both said to possess the same specific gravity, boiling-point, and vapour density, and it would, therefore, be gratifying to learn that some skilful analyst had succeeded in discovering tangible differences in certain of their physico-chemical relations and properties.

The limits of this paper will not allow of my enlarging on a theme so portentous and prolific as the molecular structure and chemical deportment of the anhydrous organic acids. In drawing to a close, I shall, therefore, confine my remarks to one or two leading features in that class of anhydrous acids which, like those mentioned in the text, are found to exhibit, in their combinations with bases, an uneven aggregate number of enveloping non-metallic elements. A careful comparison between this and the other class of acid anhydrides, which in the free state, as well as in their combinations with bases, present an even aggregate number of enveloping non-metallic elements, has revealed, amongst others, one theoretically most important point of difference between them, which is, that the members of the first class of anhydrides always

exist in the condensed form of couplets, possessing double the atomic weight exactly of what belongs to them in their chemical union with bases; whereas, in the members of the second class of anhydrides, the atomic weight remains constant simply because there is no condensation.

I shall illustrate these typical differences by means of the oxalic and carbonic anhydrides, which, by their respective formulæ, are shown to be—the former, a product of the chemical union of two molecules of oxalic acid, as it exists in its salts under the altered forms of carbonous and carbonic acid; while the latter is a molecule of unaltered carbonic acid pure and simple.

Now, with the aid of certain pregnant, but still unpublished, speculations regarding the real character of molecular substitution, as conceived in the spirit of the "typo-nucleus" theory, I hope to be able to prove that, when the oxalic anhydride splits up into its components, the metamorphoses do not consist (as a *prima facie* view might lead us to suppose) in the direct separation of the carbonous from the carbonic acid, but that it is wrought on the principle of molecular substitution, where two conspiring molecules of anhydrous oxalic acid, by the interchange of a molecule of carbonous for one of carbonic acid, give rise, on the one hand, to two chemically independent molecules of free carbonous, and, on the other hand, to two chemically independent molecules of free carbonic acid.

It is noteworthy, however, and constitutes a second leading feature in this class of molecules, that, when chlorine forms part of their envelopes, the condensed twin-acids are prone to experience yet another and different mode of dissociation from what has just been exemplified in the case of anhydrous oxalic acid. By this characteristic and equally common mode of bi-partition, which involves the transfer of one molecule of chlorine from one of the two acid components to the other, the two chemically identical and independent halves have now acquired the interesting, but variously misconstrued, faculty of interchanging that particular, and, in all probability, typically altered, molecule of chlorine for a multitude of similarly modified simple and complex organic and inorganic molecules. In illustration of this kind of metamorphosis, I may adduce the case of phosgen, which, under the influence of temperature, is made to split up into two equal halves, according to the equation—

$$2\overline{Fo}O_2,2\overline{Fo}Cl_2O_2 = 2\times 2\overline{Fo}O_2,Cl.$$

While I am obliged to reserve the deeper consideration of this and other kindred questions for a separate communication, I may yet, in conclusion, be permitted to express an anxious hope that the broad and original views I have felt it my duty to bring to the knowledge of the chemical profession, on account of the superior insight which these views are calculated to procure into the chemical constitution of the chlorinated methyl and ethyl ethers, as also of the chlorinated combinations of these ethers with formic, acetic, oxalic, and carbonic acids—I repeat, that these confidently, but modestly, proclaimed new conceptions and doctrines—may soon have applied to them the touchstone of those judiciously planned and carefully conducted experiments, which cannot fail to suggest themselves to the minds of so many intelligent and truth-seeking explorers of nature's hidden treasures and secrets.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 18th, 1875.

Professor Abel, F.R.S., President, in the Chair.

After the names of the visitors had been announced and the minutes of the preceding meeting read and confirmed, the following names were read for the first time:—Messrs. W. Harkness, W. A. Stewart, A. Smetham, J. Davies Mucklow, H. G. Ivey, B. S. Dyer, A. E. Evans, G. Cheverton, A. Talbot, and G. H. Bailey. For the third time—Messrs. John Alfred Parry Price, B.A., Archibald Simon Lang McDonald, A. M. Graham, and William Davis, who were balloted for and duly elected.

The President said he was happy to announce that they had almost completed the furnishing of the laboratory with apparatus for the purpose of illustrating the papers brought before the Society, and hoped it would add considerably to the interest of them. They had received a present of a balance from Mr. Longstaff, and from Dr. Frankland a Sprengel pump, with the necessary quantity of mercury.

The Secretary then read a paper "*On Ethyl-Phenyl-Acetylen*," by Mr. T. M. Morgan. The sodium-derivative of phenyl-acetylen, a hydrocarbon discovered some years ago by Glaser, when treated with ethyl-iodide, yields a product from which a colourless liquid, ethyl-phenyl-acetylen, may be isolated by careful fractional distillation. It boils at 201° C, and combines with hydrobromic acid. The mono-bromide thus formed, when digested with sodium acetate and subsequently treated with potassium hydrate, gives an alcohol of the formula $C_{10}H_{12}O$, and boiling at about 225° C.

The President having thanked the author,

Dr. C. R. A. Wright read a communication "*On Narcotine, Cotarnine, and Hydro-Cotarnine*," by himself and Mr. G. H. Beckett. The action of water on narcotine hydrochloride is similar to that on the narceine salt, splitting it up into hydrochloric acid and basic salts. The action of ethyl-iodide on hydro-cotarnine produces a compound of the formula $C_{12}H_{15}NO_3,C_2H_5I$, and this, when decomposed by silver hydrate, yields a strongly alkaline solution which absorbs carbonic acid from the air. This resists the further action of ethyl-iodide, so that hydro-cotarnine is a nitrile base, and its formation from cotarnine is parallel with that whereby acetylen is converted into ethylen. The prolonged action of ethyl-iodide on narcotine completely converts it into the ethiodide, but the product is not crystalline and is readily decomposed; the authors, however, succeeded in obtaining a platinum salt. Similar results were obtained with cotarnine, but the resulting compounds are more stable. The action of acetic anhydride on narcotine, cotarnine, and hydro-cotarnine were also tried, but with negative results.

There are two appendices to this paper, one "*On the Physiological Action of the above-mentioned Ethyl Compounds*," by Dr. F. Pierce; the other "*On the 'Structural' Formulæ of Narcotine and its Derivatives*," by Dr. Wright; in which, after reviewing the work of Matthiessen and Foster on this subject, also that of Liechti, he arrives at the conclusion that the formula of opianic acid is that indicated by Liebermann and Chojnacki—

$$C_6H_2(OCH_3)_2(COOH)(COH),$$

and consequently the structural formula of narcotine is—

$$(COH)(OCH_3)_2C_6H_2-CO-[C_{11}H_{11}(CH_3)O_3]\equiv N.$$

Dr. Armstrong, after remarking that Dr. Wright had not given any evidence in favour of the formula—

$$C_6H_2(OCH_3)_2(COH)(COOH),$$

for opianic acid, said that some months ago he had stated before the Society that he had found that opianic acid, when heated with zinc chloride, yielded vanillin—

$$C_6H_3(OCH_3)(COH)(OH),$$

and had thence deduced the formula for opianic acid given above.

Dr. Wright replied that he hoped shortly to lay before the Society Part III. of these researches, which contained the evidence for the formula of opianic acid; and the speaker then briefly stated several reactions which he had observed which tended to support the view that this formula represented our knowledge of the subject, especially the relation which exists between pyrocatechin and hemipinic acid on the one hand, and protocatechuic acid and opianic acid on the other.

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Mr. W. Noel Hartley then read a paper "*On the Presence of Liquid Carbon-Dioxide in Mineral Cavities.*" The author, after summarising what had already been published on this subject, especially noticing the observations of Davy and Brewster, described his experiments on a microscopic specimen of quartz with fluid cavities obtained from Mr. Norman. He observed that, on heating the specimen to 36° C., the liquid disappeared completely, but returned on cooling; a determination of the critical point was, therefore, made, and was found to lie between 30·75° and 31° C. Andrews's determination of the critical point of carbon dioxide places it at 30·92° C., so that there can be no doubt as to the nature of the liquid in the quartz cavity examined. After the meeting, the author exhibited the specimen described.

The President, in thanking the author, observed that his application of Dr. Andrews's method was of great interest, and likely to throw considerable light on the nature of the liquids in the cavities of various minerals.

Mr. Field said it was very curious that quartz with these cavities was only found in certain districts; for instance, he only knew of two in the north of Chili, and in Cornwall, which was peculiarly rich in large quartz crystals, they were only found in the mine De la Bole, near Bos Castle. Mr. Talling told him he once possessed a cubic crystal of quartz, a pseudomorph, which contained about a fluid ounce of a liquid in a cavity.

Professor Church had a crystal of fluor-spar from Cornwall which formally belonged to Sir David Brewster, and which had a cavity nearly half an inch long, partly filled with liquid.

The last paper was "*A Preliminary Notice on the Formation of Coumarin, Cinnamic Acid, and other similar Acids,*" by Mr. W. H. Perkin. The author found that coumarin may readily be prepared by boiling salicylic aldehyd with acetic anhydride and sodium acetate. By treating benzoic and other aldehyds with the same reagents, they are found to yield acids, and, moreover, by varying the anhydride and the salt, a great variety of new acids can be obtained. Succinic anhydride and a succinate, when heated with benzoic aldehyd, also gives a beautifully crystalline acid. The following acids have already been prepared by this process and analysed:—Cinnamic acid, $C_9H_8O_2$; α and β methyl-oxycinnamic acids, $C_9H_7(CH_3O)O_2$; phenyl-crotonic acid, $C_{10}H_{10}O_2$; phenyl-acrylic acid, $C_{11}H_{12}O_2$; cumenyl-acrylic acid, $C_{12}H_{14}O_2$; and cinnamyl-acrylic acid, $C_{11}H_{10}O_2$.

The President, having thanked the author for his most interesting communication, adjourned the meeting until the 2nd of December, for which several papers are announced, including "Communications from the Laboratory of the London Institution, by H. E. Armstrong; "On certain Bismuth Compounds," by M. M. P. Muir; "On the Decomposition of Alcohol and its Homologues by the joint action of Aluminium and its Halogen Compounds," by J. H. Gladstone and A. Tribe; "A Note on Incense Resin," by J. Stenhouse and C. E. Groves; and "Narcotine, Cotarnine, and Hydrocotarnine (Part III.)," by C. R. A. Wright and G. H. Beckett.

CORRESPONDENCE.

ON THE FLUORIDES OF ARSENIC AND PHOSPHORUS.

To the Editor of the Chemical News.

Sir,—As your report of the reading of my paper before the Chemical Society is apt to mislead your readers, I beg permission to make a few remarks regarding it. Your reporter states that I prepare arsenic trifluoride by distilling a mixture of arsenic trichloride, calcium fluoride, and sulphuric acid, whereas I use a modified Dubrunfaut's mixture, in which the arsenic-containing constituent is the trioxide, and not the trichloride. Your report would, further, lead one to suppose that phosphorus trifluoride was a liquid boiling above 60° C., which is not correct. PF_3 is a gas under normal conditions of temperature and pressure.

Regarding Dr. Armstrong's remarks, I shall, for the present, content myself with stating that, when PBr_3 or PCl_3 (preferably the former) is agitated with AsF_3, a slow decomposition sets in, whereby heat is given out and PF_3 formed. The change may be much accelerated by the application of a gentle heat.—I am, &c.,

R. W. Emerson Macivor.

NOTES UPON SUGAR ANALYSIS.

To the Editor of the Chemical News.

Sir,—I intended, as you would observe by my letter of the 15th inst., taking no notice whatever of your anonymous correspondents, "Beet" and "Cane," for the plain simple reason that I make it a rule never to reply to such. But having been invited by yourself to make an explanation, I think it is only a matter of courtesy to the readers of the Chemical News that I should do so.

With regard to the "similiarity," &c., allow me to assure such that if there is such a similarity in existence it is purely accidental. A few of "the notes" in dispute were given me to copy from the laboratory books of a firm of analytical chemists when studying the subject some years ago with them; while others were given to me for a similar purpose by brother students working at the same benches and in the same laboratory. These extracts were copied into my own laboratory books, and from them were accidentally transferred by mistake to my "proof sheets," along with numerous other jottings of my own, when preparing the paper upon "Sugar Analysis."

Where all these notes were originally obtained the parties from whom I received them know best themselves. Certain am I that had I observed this sooner they would not by any means have been reprinted. For *all* the analytical work and experiments, including the section on the "Volumetric Estimation of Fruit-Sugar," I am indebted to myself.

Sir, I earnestly hope this explanation will give satisfaction to your numerous readers, and that you will give this note a corner in an early number of your journal.—I am, &c.,

G. C. Stewart.

Chemical Laboratory,
Cappielow Sugar Refinery,
November 20, 1875.

MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

Sir,—Some of the conclusions of your correspondents on this subject do not quite agree with my own experience, which extends over fifteen years. Meantime, it would be of interest to elicit opinion as to a paragraph in the Chemical News vol. xxxii., p. 21, on "Sulphuric Acid Manufacture," by the late H. A. Smith, which is as follows:—"In several instances, also, which have come under my notice in the cases of manufactures of ammonium sulphate, many hundred pounds' worth of material has been lost through the use of acid containing this impurity (arsenic) while the unfortunate makers were vainly searching for their old enemy, iron."

This is somewhat enigmatical. How does the loss arise?—I am, &c.,

Carbon.

November 20, 1875.

WATER ANALYSIS.

To the Editor of the Chemical News.

Sir,—With reference to Mr. J. Carter Bell's letter on "Water Analysis" in the Chemical News (vol. xxxii.,

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p. 249), I would ask whether Mr. Bell is quite satisfied that the bottles containing the samples were *clean?* As Public Analyst for the County of Cornwall I have frequently had samples sent in foul bottles. I also observe that the samples were taken at widely different times. Before blaming Messrs. A., B., C., D., and E., Mr. Bell should be quite certain that they had identically the same water to analyse.—I am, &c.,

J. H. Collins.

Truro, November 22, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 18, November 2, 1875.

Fourteenth Note on the Electro-Conductivity of Bodies Sparingly Conductive.—M. Th. du Moncel.—This paper relates to the conductibility of metal filings, mineral dust, and moist bodies, living or inert. The filings of metal, dust of highly-conductive metallic ores, and that of graphite, or of retort-charcoal, are capable of conducting currents, but without determining electro-tonic effects of polarisation. If heated, their conductibility, at the first moment, seems to diminish more or less, but it afterwards augments rapidly to a great extent. If we cease to heat the current decreases successively, and its intensity becomes, after a time, much less than at first.

Laws which Govern Reactions of Direct Addition (Continuation).—M. L. Markovnikoff.—The author gives some details concerning his recent researches on the oxidation of propylenic chlorhydrin.

Unipolar Electric Excitement of the Nerves: Comparison of the Activity of the two Poles during the Passage of the Currents of the Battery.—M. A. Chauveau.—For every subject whose nerves are in a perfect physiological state there is an electric value—commonly very weak, sometimes moderate, but rarely very high—which gives to the two poles the same degree of activity in the case of unipolar excitement of the motor nervous bundles. The contractions produced by positive and negative excitement with this typical intensity of the current are equal, both in magnitude and duration. Below this intensity equal currents produce unequal effects with the two poles, the activity of the negative pole being more considerable. When tetanisation is produced by feeble currents it is never with the positive pole upon the nerve. Above the typical value of the intensity of the current the inequality appears in the opposite direction.

Bulletin de la Societe Chimique de Paris, Nos. 6 and 7, October 5, 1875.

Compound of Methyl Oxide and of Hydrochloric Acid.—M. C. Friedel.—Not adapted for abstraction.

Detection and Determination of Arsenic contained in Animal Matters.—M. Armand Gautier.—The author maintains that there are many methods known which serve to demonstrate the presence of arsenic in animal matter, but that none of them can be depended upon for its quantitative determination, as they are unable to extract from any tissue the whole of the arsenic which it may have absorbed. He concludes, however, that this may be effected by Marsh's process, if the organic matter is previously dealt with as follows:—100 grms. of the suspected substance are cut in pieces, and introduced whilst recent into a porcelain capsule containing 600 c.c. It is treated with 30 grms. of pure nitric acid, and moderately heated. The substance liquefies by degrees, then thickens, and takes an orange tint. The capsule is then withdrawn from the fire, and 5 grms. of pure sulphuric acid are added. The mass turns brown, and is briskly attacked. It is heated until vapours of sulphuric acid begin to escape. 10 to 12 grms. of nitric acid are then poured drop by drop upon the residue. The substance liquefies again, giving off abundant nitrous fumes. It is then heated to incipient carbonisation. The matter thus obtained is powdered, and exhausted in the capsule with boiling water. The filtrate is treated with a few drops of sodium bisulphite, and the arsenic is then thrown down as sulphide by a prolonged current of sulphuretted hydrogen. This sulphide is converted into arsenic acid by ordinary methods, and poured into Marsh's apparatus.

The Prussiates.—M. Gaston Bong.—Ferrocyanide of potassium, by its ready transformation into ferricyanide under the influence of chlorine, can be used for chlorometric operations with as much precision and ease as arsenious acid. For this purpose we employ a normal solution containing 37·765 grms. prussiate per litre, a quantity corresponding to a litre of chlorine. Of this 10 c.c. are taken, diluted with water, and acidulated with hydrochloric acid. After the solution has been coloured with a few drops of sulphate of indigo, the chlorinised solution in question is poured in until the blue colour of the indigo gives place to the brown colour ferricyanide of potassium. Determinations of yellow prussiate by means of a standard chlorine liquid can also be made in the same manner, using solution of indigo to ascertain the end of the operation, which is much preferable to the ordinary method of "spotting" with perchloride of iron. The author treats, further, on the application of yellow prussiate in acidimetric operations; and on the oxidising power of the ferricyanides—those especially of zinc, copper, and mercury—in presence of an alkali. He remarks that the three above-named ferricyanides produce aniline-black immediately at common temperatures, whilst the other metallic ferricyanides effect the same change only at elevated temperatures. The author has also examined the purple produced by the reaction of alkaline sulphides with the nitro-prussides, and announces the discovery of a new class of prussiates.

Gyratory Movement of Certain Salts on the Surface of Water.—M. H. Lescœur.—Substances possessing the epipolic force may be arranged in two classes:—1. *Bodies Insoluble in Water.*—When once they are spread out all motion is arrested, and the movement of every other body is suspended (fixed oils, fatty bodies, &c.). 2. *Soluble or Volatile Bodies.*—The superficial layer produced instantaneously dissolves, or is volatilised. The movement is continuous. The saturation of the liquid and ambient air causes all activity to cease (camphor, acetic acid, essential oils, &c.). As to the first cause of the motion, it is found in the reciprocal action of two fluid surfaces. It may be a phenomenon of capillarity, or of the superficial tension o the liquids.

Metallic Derivatives of Cyanamid and of Dicyanodiamid.—M. R. Engel.—Not adapted for abstraction.

Density of Leucin.—MM. Engel and G. Vilmain.—The specific gravity of leucin at 18° was found to be 1·293.

Volumetric Determination of Molybdic Acid.—M. A. Werncke.—M. Pisani has proposed to determine molybdic acid by reducing it to sesquioxide with zinc and hydrochloric acid, and finding then the amount of permanganate of potash needful for its re-conversion into molybdic acid. The author finds that the reduction thus obtained is not complete, and sodium-amalgam gave also an imperfect reduction. The results obtained are, however, mutually comparable.—*Zeitschrift für Analytisch Chemie.*

Volumetric Determination of Sulphuric Acid in Waters.—M. W. Hempel.—Prepare a solution of nitrate of barium containing 5 grms. per litre, and a solution o potassium chromate equivalent to the former. To 100 c.c of the water in question add a volume of the barytic sol u

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tion sufficient to precipitate the total sulphuric acid, and determine then by means of the solution of potassium chromate the excess of the baric salt added, using, in order to recognise the end of the reaction, a drop of silver nitrate upon a white porcelain plate. When there is an excess of the chromate the drop assumes at once a reddish brown colouration; a colouration which only appears after some time is due to the decomposition of the barium chromate suspended in the liquid by the silver nitrate. The results obtained are very satisfactory.—*Zeitschrift für Analytische Chemie.*

Determination of Small Quantities of Cobalt in Nickel.—M. Fleitmann.—When a liquid contains only 1 part of cobalt to 100 of nickel, the separation cannot be effected by means of potassium nitrite on account of the solubility of the double nitrite of potassium and cobalt. In this case the author proposes to precipitate the cobalt along with a certain quantity of nickel (about twice its own weight) by adding to the solution a suitable quantity of hypochlorite of soda. This salt throws down, first, the cobalt as brown peroxide, and afterwards the nickel as black peroxide. When about 2 parts of nickel have been precipitated, for 1 part of cobalt existing in the liquid we may be sure that only a trace of cobalt remains in solution. With a little practice it is easy to decide from the colour of the precipitate whether enough hypochlorite has been added. The precipitate is washed, dissolved in hot hydrochloric acid, and precipitated with potassic nitrite, observing the known precautions.—*Zeitschrift für Analytische Chemie.*

On Filtration.—M. Fleitmann.—The author remarks that a filter fitting closely to the funnel acts less rapidly than a double filter of the same texture, and this again less rapidly than a threefold filter.—*Zeitschrift für Analytische Chemie.*

Separation of Tin from Antimony and Arsenic.—M. C. Winkler.—If the substance is an alloy dissolve in a mixture of 4 parts of hydrochloric acid, 1 part nitric acid, and 5 parts water, adding so much tartaric acid that the solution may not become turbid on the addition of water. If the three elements are in the state of sulphides, they are dissolved in dilute potassa; chlorine is passed into the solution, and bromine added until these two bodies are in excess. The liquid is then neutralised with hydrochloric acid, and tartaric acid is added. In either case the solution is diluted to 300 or 400 c.c., and a solution of chloride of calcium added in such quantity that the carbonate of lime precipitable therefrom may be about fifteen times the weight of the tin in the solution. Neutralise with carbonate of potash, precipitate the tin with cyanide of potassium, and finally throw down the calcium of the chloride with a slight excess of carbonate of potash. Under these conditions the tin is deposited alone, the antimony and arsenic remaining in solution. The liquid is boiled to render the precipitate of calcic carbonate more dense, and that it may imprison the gelatinous stannic acid and permit it to be washed. When the precipitate is settled it is three times washed with boiling water by decantation. If an absolutely exact separation is required the precipitate is re-dissolved in a little hydrochloric acid, and re-precipitated with cyanide and carbonate of potassium as before. Lastly, the precipitate is thrown on a filter, washed, dried, and ignited to convert the stannic acid into the insoluble modification. Lastly, it is treated with hydrochloric acid, which removes the lime. The residue is then collected on a small filter, washed, ignited, and weighed.—*Zeitschrift für Analytische Chemie.*

Determination of Nitric Acid in Water.—M. F. Gramp.—The author finds that sodium-amalgam in presence of an excess of potassa is the best agent for reducing nitric acid to ammonia. For 0·1 grm. nitrate of potash dissolved in 60 grms. of water he employed 40 grms. of sodium amalgam, and found that the whole of the nitric acid was converted into ammonia without any loss.—*Journal für Praktische Chemie.*

Ebony-Black Stain for Wood.—E. Lauber.—Extract of logwood is dissolved in water till the liquid stands at 10° B.; 5 litres of this solution are mixed with half the measure of pyrolignite of iron at 10° B., and 0·5 litre acetic acid at 2° B., and the mixture is then heated for a quarter of an hour.

Nos. 8 and 9, November 5, 1874.

Synthetic Researches on the Uric Group.—M. Edouard Grimaux.—This long and important paper is not suited for abstraction.

Certain Ferro-Cyanides.—M. A. Atterberg.—The author has prepared and examined the ferrocyanides of molybdenum, tungsten, uranium, vanadium, niobium, tantalum, titanium, tin, tellurium, antimony, and bismuth.

Certain Glucinium Compounds.—M. A. Atterberg.—The author describes the chloride of glucinium and ethylic ether, the basic chloride, the platino-cyanide, phosphate, and two arseniates of glucinium.

Formation of Alizarin by the Reduction of Rufigallic Acid.—M. O. Widman.—On treating rufigallic acid with water and sodium amalgam the result is a violet solution, which is saturated with hydrochloric acid. The precipitate is washed and dissolved in potassa. Chloride of barium then determines a precipitate which is decomposed with hydrochloric acid. The insoluble residue is dissolved in methylic alcohol or acetic acid, the solution is evaporated to dryness, and the residue heated to 250°. It sublimes then in very brilliant, orange-red, crystalline needles, which, on analysis, give—

Carbon	69·54
Hydrogen	3·92

The formula of alizarin requires—

Carbon	70·00
Hydrogen	3·33

The reactions of the body thus obtained are the same as those of alizarin. The formation of alizarin by rufigallic acid indicates that this acid is hexa-oxyanthraquinon, according to the conclusions of M. Jaffe. This fact easily explains the formation of alizarin in the vegetable kingdom.

Correspondence from St. Petersburg, May 3rd (15th).—M. W. Louguinine.—The death is announced of the distinguished young chemist, M. Michel Kirpicheff. M. Mendeleef describes a new and very sensitive differential thermometer. He also points out that he had described, in 1868, the hydrate $NaCl,10H_2O$, of which Dr. Guthrie gives an account in the *Philosophical Magazine*, No. 1, 1875. M. Boutlerow, on behalf of M. Setschenoff, announces that by the prolonged reaction of carbonic acid upon a solution of sodic acetate, saturated at ordinary temperatures, carbonate of soda is formed, whilst acetic acid was set free. On behalf of M. Popoff he also presented a paper on the communication of M. Markownikoff on the oxidation of α-oxybutyric acid. M. Wischnegradsky described three new pinacolins obtained synthetically, setting out from the chlorides of tertiary oxides and from zinco-organic compounds. M. Menschoutkine, on the part of M. Kern, described certain reactions of metallic sodium upon chloroform, and the composition of certain metallic alloys. On behalf of M. Ossipoff he gave an account of the action of sulphuric acid, of different degrees of concentration, upon amylen. On behalf of M. Trapp he described a new camphor obtained by distilling large quantities of the flowers of *Ledum palustre*. The fourth part of the seventh volume of the *Journ. de la Soc. Chim. Russe* contains, also, a preliminary notice by MM. Petrieff and Eguis, "On the Action of Sodium-Amalgam on the Neutral Ethers of Certain Mono-Basic Acids;" a paper by M. W. Roudneef "On the Products of the Reduction of Trichloro-lactic Acid;" a memoir by M. Wischnegradsky, "On the Condensation of Iso-Amylen;" and a preliminary notice by M. Kazantzeff, "On the Action of Hydriodic Acid on Aceton and Phoron."

Tannic Acid of Divi-Divi.—M. J. Lœwe.—The tannin of divi-divi, the pods of *Cæsalpinia coriaria*, is little known:

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according to Stenhouse it differs from gallo-tannic acid. The author confirms this view: he has prepared the tannin of divi-divi in a state of perfect purity. He names it ellago-tannic acid, and finds that it is a yellow powder, which, when dried at 100°, yields on analysis C = 49·70, and H = 3·16 per cent. These figures indicate the formula $C_{14}H_{10}O_{10}$, which differs from that of gallo-tannic acid by containing one more atom of oxygen. It possesses reactions resembling those of ordinary tannin. It precipitates solutions of gelatin, albumen, the alkaloids, and tartar-emetic. It yields with acetate of lead a yellowish drab precipitate, which, when dried at 100°, contains— $2(C_{14}H_{10}O_{10})5PbO$; with acetate of copper it gives a light brown, and with acetate of iron a black precipitate. If heated for some hours to 108° to 110° the aqueous solution becomes turbid, and deposits a pale powder, the composition and properties of which agree with those of ellagic acid, $C_{14}H_6O_8$. The ellago-tannic acid has, therefore, merely lost 2 molecules of water. It is known that impure gallo-tannic acid yields, likewise, a certain amount of ellagic acid under the influence of dilute acids, whilst the pure acid does not display this reaction. It is probable, therefore, that crude tannin, besides gallo-tannic acid, contains some ellago-tannic acid. Divi-divi contains gallic acid along with ellago-tannic acid.

Tannic Acid of Myrobalans.—M. J. Lœwe.—The tannin of myrobalans is identical with that of divi-divi. It has the same composition, properties, and decompositions.—*Zeitschrift fur Analytische Chemie.*

Tannin of Hungarian Galls.—M. J. Lœwe.—The gall of Hungary and Piedmont is an anomaly of the cup of the acorn of the common oak, occasioned by the sting of a cynips. It is used in tanning. The galls contain an inconsiderable amount of a tannin which the author finds identical with that of gallo-tannic acid, $C_{14}H_{10}O_9$.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. No. 23, November, 1875.

Report Given in by M. de Luynes, in the Name of the Committee of Economical Arts, on the Processes of M. de la Bastie for Tempering Glass.—The Committee consider that the chief objection to the use of tempered glass is the difficulty of cutting it with a diamond.

Report Delivered by M. Salvetat, in the Name of the Committee of Chemical Arts, on the Work of MM. Girard and de Laire, entitled "Traité des Dérivés de la Houille" (Treatise on the Derivatives of Coal).—A critique on an excellent work, which now comes decidedly too late.

The other chemical papers in this issue have been already noticed.

British Rivers. Things not Generally Known.—The New York *Graphic* tells us that "the pollution of rivers is a topic that taxes the attention of British sanitarians to the utmost. The extent of the difficulty is certainly alarming. Nor is it caused solely by the sewage of cities and towns, bad as that is. The rivers are lined with manufactories of all sorts, chemical works, machine shops, and dye houses, all of which pour their poisonous refuse into the rivers. And so great is the pollution of the water in some instances that when a light was applied to some of it dipped from the river at Bradford it actually burned. A man who accidentally tumbled into a river and swallowed a mouthful of water died of the effects. The effluvia that rises from the Clyde produces sickness in summer time, and the Mersey emits an unbearable stench. The water of the Bourne is yellow as ochre and thick as glue, and the horse that drinks it dies. And all the rivers are more or less affected in the same way, and the fish that survive in some of the streams are so unwholesome that they are unfit for food, if not dangerous."

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the treatment of starch and starchy substances, and the production therefrom of a compound body capable of being used as a substitute for malt in brewing, and for other purposes. Cornelius O'Sullivan, brewer, Burton-on-Trent, Stafford, and William George Valentin, of the Royal College of Chemistry, South Kensington, Middlesex. November 12, 1874.—No. 3909. This invention consists in producing from starch or starchy substances a compound solid body which the inventors term "dextrin-maltose," consisting of the same proportional quantities of dextrin and maltose as are ordinarily obtained from malt by the mashing process. To 100 parts by weight of starch 250 parts by weight of water are added, and from 1¼ to 2 parts by weight of concentrated sulphuric acid. The mixture is then digested at the temperature of boiling water until the solution contains the requisite proportions of dextrin and maltose, when the acid is neutralised by means of calcic hydrate or carbonate. The solution is afterwards freed from the insoluble calcic sulphate which has been formed, and when evaporated to dryness yields the solid "dextrin-maltose."

Improvements in preserving animal and vegetable substances. J. G. Tongue, Southampton Buildings, Chancery Lane, Middlesex. (A communication from Edouard Vincent Jules Laurent Gorges, chemist, Paris.) November 17, 1874.—No. 3946. This invention relates to a new process or means of preserving animal and vegetable substances in their natural state. In order to preserve a whole animal or carcass, sulphurous gas is forced into the white tissues between the skin and the flesh; this is obtained by means of an india-rubber tube and bellows in communication with a bottle or chamber containing liquid bisulphate of soda, lime, or manganese. A liquid containing 1 per cent of pure chloric acid, or any other acid which is not injurious to health, is then forced into the carotid artery or aorta. The animal having been skinned, and the entrails taken out, when the carcass is cold it is submerged in a bath composed of a solution similar to that above described. In order to preserve the flesh of fish, wash it well in a solution containing about 1 per cent of chloric acid; and it may then be kept in a solution containing phosphate of soda dissolved, and an addition of 3 per cent of chloride of sodium. In order to preserve all kinds of vegetables, they must be kept one or two minutes in boiling water, then left to cool, and afterwards put into tin boxes, bottles, or casks, which are then filled with water containing 10 per cent of phosphate of soda, or any other salt of soda; add 1 per cent of carbonate of soda and salt. Mushrooms are preserved by being kept for one or two hours in a solution containing 5 or 6 per cent of any kind of sulphate or bisulphate of soda or lime, then submerged into boiling water during one or two minutes, and after cooling in the first solution they are put into bottles or tin boxes, and filled with a solution similar to the preservation of vegetables as above described, or one or two per cent of any kind of bisulphate may be used. All kinds of fruits may be preserved in their natural state by being kept in a solution saturated with any kind of salt of soda, tartrate, chlorite, phosphate, and with an addition of sugar.

Improvements in the manufacture of sugar for brewing and other purposes. W. Garton, Southampton. November 17, 1874.—No. 3950. This Provisional Specification refers to the manufacture of sugar composed partly of dextro-glucose obtained from amylaceous substances, and partly of lævo-glucose obtained from cane or other sugar-producing substances. When amylaceous substances are being converted into dextro-glucose by means of acid and heat in the ordinary way, the conversion ceases as soon as the solution has attained a specific gravity of about 1·070, and it has then been usual to neutralise it, and to concentrate it by evaporation. On the other hand, in treating cane or other sugar to obtain lævo-glucose, an inversion may be effected in solutions of specific gravity of even 1·200 to 1·275. Now, according to this invention, when the solution containing the amylaceous substances has reached the point beyond which no further conversion can be effected, the inventor takes advantage of a fact which he has ascertained by experiment, viz., that the acid employed in converting is further capable of inverting large proportions of crystallised sugar, while the glucose obtained from the amylaceous substance is still in the solution. He therefore adds sufficient cane- or beet-sugar to increase the gravity to about 1·275, and when the inversion is complete he neutralises the acid solution containing both the dextro- and lævo-glucose. Great economy is thus effected.

Improvements in separating tin and zinc from iron and other impurities, and also in separating from silver and lead the zinc which has been employed in desilvering the lead. F. W. Dahne, Swansea, Glamorgan. November 19, 1874.—No. 3978. This invention mainly relates to separating zinc, tin, and other metals which have been used for galvanising and such like purposes, by using as prescribed the muffle as ordinarily employed, with a charge or bed of coal, coke, charcoal, or other suitable material, which the inventor terms a filter. In this muffle so charged a small opening is left in the lower part. The action is in general terms described in the Provisional Specification.

Improvements in the manufacture of beer. C. Laubarede, Percy Street, Fitzroy Square, Middlesex. (A communication from V. P. C. Baud and A. A. Saulxures, Paris.) November 19, 1874.—No. 3982. Maize is steeped in a solution in water of sulphite, bisulphite, or hyposulphite of potash, soda, or lime, and then exposed to the influence of the atmosphere until it is dried on the surface. The maize is then broken into particles by the action of a grinding mill, and can be dried and preserved, or may be used in a moist state. In either case it is combined with barley-malt and employed for the purposes of brewing.

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MEETINGS FOR THE WEEK.

SATURDAY, Nov. 27th.—Physical, 3. "On Stationary Waves," by Dr. F. Guthrie. Exhibition of Dr. Kerr's experiments on the influence of electrification on polarised light.
MONDAY, 29th.—Royal Geographical, 8.30.
—— Medical, 8.
—— Society of Arts, 8. Cantor Lectures: "On the Discoveries and Philosophy of Liebig, with Special Reference to their Influence upon the Advancement of Arts, Manufactures, and Commerce," by Dr. Thudichum.
TUESDAY, 30th.—Civil Engineers, 8.
—— Royal, 4. (Anniversary.)
WEDNESDAY, Dec. 1st.—Society of Arts, 8. "On the Legislative Enactments requisite for Safe Conduct of Sewage Grounds," by Alfred Smee, F.R.S.
—— Geological, 8.
—— Microscopical, 8.
—— Pharmaceutical, 8.
THURSDAY, 2nd.—Chemical 8. "On certain Bismuth Compounds," by M. M. Pattison Muir; "On Bismuthiferous Tesseral Pyrites," by Dr. William Ramsay; "On the Decomposition of Alcohol and its Homologues by the Joint Action of Aluminium and its Halogen Compounds," by Dr. Gladstone and Mr. Tribe; "Note on Incense Resin," by Dr. Stenhouse and Mr. Groves; "On the Occurrence of Native Calcium Chloride at Guy's Cliff, Warwickshire," by J. Spiller. "On Certain Sources of Error in the Ultimate Analysis of Organic Substances containing Nitrogen," by G. S. Johnson.
—— Society of Arts, 8. Adjourned discussion on the paper by H. T. Wood, B.A., "On the Registration of Trade Marks."
FRIDAY, 3rd.—Geologists' Association, 8.
—— Society of Arts, 8. Special Lectures: "On Unhealthy Trades," by Dr. B. Richardson (Lecture I.).

TO CORRESPONDENTS.

P. H.—A correspondent suggests that you may find the information you require in "Traité Complet, Théorique et Pratique de la Fabrication du Sucre, Guide du Fabricant;" published at 20 francs. Eugéne Lacroix, Paris.

G. Evans.—Apply to the Secretary, Burlington House, Piccadilly, London, W.

The Committee of the Fund now being raised for the Family of the late Dr. SCHENK, F.C.S., begs to acknowledge the following sums, received since the 16th instant:—

Previously acknowledged, £328 4s.

M. J. Salter	£1	1	0	J. Schweitzer	£1	1	0
M. C. Young	0	10	0	Jas. S. Merry	0	10	6
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Edward G. Schweitzer	1	0	0				

The following are the earliest contributions, received prior to the 4th instant and acknowledged by post:—

Arthur Vacher	£5	0	0	Alfred Tribe	£2	2	0
E. Beanes	5	0	0	H. Wills	0	10	6
Dr. Stenhouse	5	0	0	Rev. G. Voigt	2	2	0
Prof. Attfield	2	2	0	Prof. Tuson	1	1	0
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Prof. Gladstone	20	0	0	A. B. Allen	0	10	0
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The Committee will gladly receive further contributions.

ALFRED TRIBE, Hon. Sec.

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NOTICE.

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THE CHEMICAL NEWS.

Vol. XXXII. No. 836.

ON NOXIOUS AND OFFENSIVE TRADES AND MANUFACTURES.*

WITH ESPECIAL REFERENCE TO THE BEST PRACTICABLE MEANS OF ABATING THE SEVERAL NUISANCES THEREFROM.

By H. LETHEBY, M.D., M.A., &c.;
Professor of Chemistry in the College of the London Hospital; late Medical Officer of Health and Public Analyst for the City of London; and President of the Society of Medical Officers of Health.

Amongst the nuisances defined in the various Acts of Parliament, general and local, are those occasioned by the operations of trade and industry. Sections 27 and 28 of the Amended Nuisances' Removal and Diseases Prevention Acts (18 and 19 Vict., c. 121) express in a general way the character of these nuisances and the methods of procedure in cases of default. "If any candle-house, melting-house, melting-place, or soap-house, or any slaughter-house, or any building or place for boiling offal or blood, or for boiling, burning, or crushing bones, or any manufactory, building, or place used for any trade, business, process, or manufacture causing effluvia, be at any time certified to the local authority by any medical officer, or any two legally qualified medical practitioners, to be a nuisance or injurious to the health of the inhabitants of the neighbourhood, the local authority shall direct complaint to be made before any justice, &c., for the suppression or mitigation of the nuisance complained of;" and by the Sanitary Act, 1866 (29 and 30 Vict., ch. 90, s. 18), a like power of initiating proceedings is given to any ten ratepayers of the place in which such nuisance exists, on a requisition in writing to the local authority. In case of such procedure, it is necessary, not only to show that the trade or business complained of "is a nuisance, or causes effluvia injurious to the health of the inhabitants of the neighbourhood," but also that the person complained against has not "used the best practicable means for abating such nuisance, or preventing or counteracting such effluvia."

It follows, therefore, that the supervision of such trades and manufactures, and the maintenance of them in such condition as that the best practicable means are constantly used to prevent the escape of offensive effluvia, forms one of the most important duties of the Medical Officer of Health; and as, in a professional capacity, I have had occasion frequently to visit and inspect most of the manufactories belonging to this category, I have thought that a brief account of my experience in the matter might be acceptable to my professional colleagues.

And here I ought to state that, on entering upon any nquiry of this description, it is proper to keep in mind the evident intentions of the Legislature, namely, the maintenance of the public health and comfort with due regard for the necessities of industry; for it will be observed that, although the preservation of the public health has been considered by Parliament of such paramount importance as to justify enactments containing enormous arbitrary powers, yet the exercise of those powers is always guarded with such provisos as will prevent abuse, and, thereby, unnecessary injury to trade. It is fortunate that, in most cases, the interests of the public and the manufacturer, although apparently conflicting, are really in accordance; for that which is injurious to the public is frequently a wasteful loss to the manufacturer; and therefore the prevention of such waste by reasonable contrivances has a double advantage. This may not be apparent at first sight to the chief parties interested, for it has often happened in the course of my professional practice that the suggestions which I have offered for the mitigation of a nuisance have not been readily accepted by the manufacturer, although in the end they have been gratefully acknowledged. I cannot, indeed, too strongly impress upon the minds of all who are concerned in such inquiries, that there need not be a feeling of antagonism in the matter; for if at any time it exists, it is either caused by a want of confidence in the skill and technical knowledge of the professional adviser of the local authority, or by an unjust and exaggerated view of the necessity for providing for the public health and comfort at all costs. This is manifestly in opposition to the spirit of the Acts of Parliament, so far as local authorities are concerned, for their duties are to see that the best practicable or available means are adopted to prevent the escape of noxious or offensive effluvia. If that fails to abate the nuisance complained of, the parties aggrieved have their remedy at law or in equity in one of Her Majesty's superior courts. On the other hand, as Mr. Keane observes, the manufacturer is bound to use the best practicable and available means to protect the public from annoyance or injury to health. It will not be enough to adopt such precautions only as are used in the place or district among persons carrying on the same business or manufacture, if it has been ascertained that there are better which are available; and in interpreting the words available and practicable, it is probable that the magistrates will pay more attention to scientific than pecuniary difficulties. It is of great importance, therefore, that the opinions of the Medical Officer of Health should be well founded, and his recommendations free from reasonable objections, for it must not be forgotten that the manufacturer, if he thinks himself aggrieved, has the right and power of appeal from the justices to a superior court, where the knowledge and judgment of the medical officer will be severely tested.

But, besides the nuisances which are caused by manufacturing operations, there are others which are more or less incidental to them, as well as to other branches of trade and industry. "Any accumulation or deposit which is a nuisance or injurious to health; or any pool, ditch, gutter, or watercourse, so foul as to be a nuisance, or injurious to health" (18 and 19 Vict., c. 121, s. 8); or "any factory, workshop, or workplace, not already under the operation of any general Act for the regulation of factories, or bakehouses, not kept in a cleanly state, or not ventilated in such a manner as to render harmless, as far as practicable, any gases, vapours, dust, or other impurities generated in the course of the work carried on therein, that are a nuisance or injurious to health;" and "any fireplace or furnace which does not, as far as practicable, consume the smoke arising from the combustible material used in such fireplace or furnace;" and "any chimney (not being the chimney of a private dwelling-house) sending forth black smoke in such quantity as to be a nuisance" (29 and 30 Vict., c. 90, s. 19)—all of which are under the supervision of the Medical Officer of Health, with a view to legal proceedings in case of default.

Looking at the individual peculiarities of these nuisances, it is evident they may be conveniently classified under three heads, namely:—

(1). Those which are caused by the escape of noxious or offensive effluvia, as gases and vapours.

(2). Those which are produced by smoke, dust, or other mechanical impurities.

(3). Those which are occasioned by the discharge of noxious or offensive matters into gutters, ditches, or watercourses.

It will not be possible to discuss in a satisfactory manner the whole of these subjects in this paper, and therefore I propose to limit your attention to the first of them, namely, to those trade nuisances which are caused by the escape

* A Paper read before the Society of Medical Officers of Health. Communicated by the Author.

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of noxious and offensive effluvia, as sulphuretted hydrogen, empyreumatic or other organic vapours, and the gaseous acids.

Foremost of those operations which cause offence by the escape of *sulphuretted hydrogen* into the atmosphere is the manufacture of *sulphate of ammonia* from gas liquor. This liquor is produced in great quantity at the gas-works—varying from 10 to 40 gallons per ton of coals, according to the strength of the liquor and the perfection of the processes for removing ammonia from gas. The strength of the liquor is estimated and expressed by its gravity in degrees of Twaddell, or by the number of ounces of strong sulphuric acid (sp. gr., 1·850) required to saturate a gallon of it. This varies from 5 or 6 ounces per gallon to 25 ounces, and, according to my experience, the proportion of sulphuretted hydrogen contained in it ranges from 230 grains, or rather less than one-third of a cubic foot per gallon, to rather more than 1250 grains, or nearly 2 cubic feet per gallon; so that the liquor is exceedingly offensive from the quantity of sulphuretted hydrogen contained in it; and therefore it is necessary to store it in air-tight tanks, and to transport it from place to place in air-tight vessels—as barrels or tank-barges, or tank-trucks. It is proper also that the orifices which give exit to the air at the time of filling the tanks should be guarded with a box or small barrel containing hydrated oxide of iron, which absorbs the sulphuretted hydrogen, producing sulphide of iron, which is subsequently revived by the action of the air.

The methods of treating this liquor with sulphuric acid so as to produce sulphate of ammonia have differed at different times and places. In my early experience, even in this metropolis, the process was to neutralise the liquor with brown acid of sp. gr. 1·720, and to convey the evolved gases into a furnace fire, as their escape into the air would be dangerous to the workmen; and the saturated liquor still reeking with sulphuretted hydrogen was evaporated in open lead troughs over open fires. The nuisance arising from these operations was absolutely unbearable; and as people got to be more and more sensitive of annoyance, the old process was discontinued. At the present time the practice is to evaporate or distil the liquor from closed boilers or chambers, and to convey the volatile products—ammonia, carbonic acid, and sulphuretted hydrogen—into a closed chamber, or saturator, containing weak sulphuric acid, there being a contrivance for the escape of carbonic acid and sulphuretted hydrogen, and the conveyance of them to a furnace fire. In some cases the liquor is distilled from boilers set over a common fire; but, as this is liable to flushes and irregularity in working, it is objectionable, and has given place to the process of distilling by means of a steam coil set in the boiler, by which steam at from 20 to 30 lbs. pressure is blown into the liquor. But the best contrivance of all is that known as Coffey's still, which consists of a vertical chamber from 20 to 25 feet in height, having a series of transverse septa which alternately leave an opening at their ends. In this way, with about sixty of such septa, a superficial area of about 1000 square feet of evaporating surface may be obtained. The liquor is delivered in a constant and graduated stream at the top of the chamber, and as it flows backwards and forwards in a descending current over the transverse septa, it meets with an ascending blast of steam which is let into the bottom of the chamber at a pressure of from 15 to 30 lbs. In this way the volatile constituents of the liquor are carried over to the saturator, where the ammonia is arrested by sulphuric acid, and the exhausted liquor flows out in a continuous stream from the bottom of the chamber. The saturator is generally an air-tight leaden vessel, about 4 or 5 feet square and 3 or 4 feet deep, containing a charge of diluted sulphuric acid —equal parts of chamber acid (1600) and water. When the acid is saturated with ammonia, which is known by test-papers, steam alone is blown into it from the still for about half on hour to displace all traces of sulphuretted hydrogen, and the solution is drawn off into open pans or troughs, where it is evaporated by means of a closed coi of high pressure steam set in the solution.

Another kind of saturator occasionally in use is a leaden vessel divided into two compartments by a diaphragm or curtain, which descends below the liquid to within about 18 inches of the bottom. One of these compartments is closed air-tight and receives the volatile products of the still, where they meet with a graduated stream of brown acid (sp. gr. 1·720), which continually neutralises them, and forms crystals of sulphate of ammonia, which are constantly ladled out of the open compartment. The apparatus is ingenious, and saves much labour and time in evaporation, as the acid is used in its undiluted condition; but it is not so certain or satisfactory in its action as the closed saturator before described.

In both cases the uncondensed gases—sulphuretted hydrogen and carbonic acid—with much steam, are conveyed from the saturator through a 4-inch pipe to the furnace fire, where the sulphuretted hydrogen is burnt. It is necessary, however, that the sulphuretted hydrogen should be deprived of its moisture before it reaches the fire, or it will extinguish it; and this is effected by throwing the pipe into coils, or otherwise cooling it. The precautions, therefore, to be taken in the conduct of this business are:—

(1). The transport and storage of the gas liquor in air-tight tanks guarded with boxes of hydrated oxide of iron.

(2). The distillation of the liquor in a steady and continuous manner in air-tight stills by means of high-pressure steam.

(3). The saturation of the ammonia in close vessels, and the complete expulsion of sulphuretted hydrogen from the saturated solution before it is drawn off for evaporation.

(4). The condensation of moisture from the sulphuretted hydrogen evolved from the saturator; and the conveyance of the cold dry gas to the furnace fire where it is to be completely burnt.

(5). The treatment of the exhausted liquor from the still with cream of lime, so as to recover the residual ammonia by a second distillation; or, if the process be in operation at a gas works, the use of the residual ammonia as an absorbent in the purification of gas.

(6). The observance of the greatest care as regards the tightness of all parts of the apparatus.

Another operation which demands care in its management is the *distillation of coal-tar* for the various products derivable from it. There are two kinds of tar from coal, according as the temperature of distillation is high or low, and according to the richness of the coal in hydrocarbon. One is ordinary coal-tar, and the other is the tar from which paraffin oils are obtained. The tar produced from common coals at a high temperature (common coal-tar) is always heavier than water (sp. gr., 1·120 to 1·150); it dries freely in the air by oxidation; it contains hydrocarbons with such an excess of carbon that they cannot be burnt in a common lamp; it is almost entirely destroyed by strong oil of vitriol; it contains much sulphur, and its percentage composition is about 86 carbon, 7 hydrogen, 6·5 oxygen, and 0·5 sulphur. Whereas the tar produced from cannel coal at a low temperature is lighter than water (sp. gr., about 0·900); it will not oxidate, or dry in the air, it contains hydrocarbons of the paraffin series which are comparatively poor in carbon, and which can be burnt in a lamp; it is not much acted on by oil of vitriol; it contains little or no sulphur; and its percentage composition is about 84 carbon, 12 hydrogen, and 4 oxygen. Both of these tars are the subjects of technical manipulation, and if not properly managed are the cause of nuisance, as are also the processes used in their primary production. In dealing with ordinary coal-tar, it is proper that it should be stored and carried in air-tight tanks, and left covered with a little water. The delivery of it into tank-barges or tank-trucks, and from them into the tanks of the works,

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should be by means of pumps and air-tight flexible hose; and the openings of the barges and tanks should be guarded with a box containing hydrated oxide of iron, as in the case of ammoniacal liquor.

The distillation of coal-tar is always conducted in iron stills set over a naked fire—the stills are of varying capacity, from 1200 to 5000 gallons, and the crown of them is always protected with brick-work to keep them hot, so that the later volatile products may not cool and condense and fall back into the still. The time of the distillation of a charge is from twelve to fifteen hours, according to the capacity of the still; and the products are first condensed in a worm or pipe kept cool in water, from which they are received into a specially-contrived box (varying in form and construction at different places), which permits the several products to flow away by separate pipes (four or five in number, and each provided with a tap) to their several tank receivers. This box is made air-tight (its cover being guarded by a water-valve), and it is provided with an ascending-pipe, which carries the foul gases to proper purifiers before they pass into the furnace-shaft. The gases which are evolved during the process of distillation are, first sulphuretted hydrogen from the ammoniacal liquor which always accompanies the tar, then gaseous or uncondensable hydrocarbons, and finally the acrid vapours of the superheated pitch with an abundance of sulphuretted hydrogen. These gases and vapours should be made to pass, first through a vertical condenser or scrubber charged with a stream of cold water, and then through an oxide of iron purifier with two or three trays of oxide, and finally to the furnace-shaft. The necessary draft for these operations should be secured by means of a fan, or by the aid of the furnace-shaft. It is proper to mention that, unless there is a draft of considerable power, the unavoidable leakage from the constantly loosening joints of the pipes will not be prevented. It is right, also, to state that it is dangerous to convey these gases and vapours into a furnace fire, as they are explosive when mixed with air, as they necessarily will be.

The products of the distillation of coal-tar vary in different places. At one time they were but four, namely:—First, ammoniacal liquor and very light naphtha, which come over before the tar in the still begins to boil; second, a crude naphtha which floats upon water, and is therefore called "light oil;" third, a creosote oil which sinks in water, and is called "heavy oil;" and fourth, the residuum, which is a soft pitch. At present, however, in well-conducted works, the creosote or dead oil is run off in two portions, namely, an early portion, consisting of creosote and heavy naphtha, which is used for burning in furnaces; and a later portion, which is best suited for the preservation of timber. This is followed by a greenish oil, which is sometimes collected apart and re-distilled with the anthracen oil that runs from crude-pressed anthracen; and then follows a green oil (anthracen oil), which is allowed to flow until it gets very thick from the presence of chrysen—the residuum in the still being hard pitch. It is in the later stages of the process, when the high temperature of the still causes the decomposition of the pitch, that sulphuretted hydrogen and acrid vapours are evolved; and this also is the cause of the nuisance from the hot pitch when it is run off from the stills into open pits. To guard against this, it is proper that the fire should be raked out from under the stills directly the process is over, and the pitch should remain in the stills to cool for ten or twelve hours; it should then be run into close receivers, or into a properly constructed chamber, and allowed to cool for twenty-four hours before it is discharged into the final receiver. All these should be ventilated so as to convey the vapours through the scrubbers and purifiers before mentioned. An excellent form of receiver for the pitch from the stills is a long air-tight chamber, which will bear internal pressure, and which communicates at the bottom with an outside trough, into which the cool pitch is forced by the weight of the hot pitch at each time of its discharge from a still. The pitch, when cooled to a temperature of about 180° or 190° F., may be freely exposed to the air, and be either run into pits or ladled out into moulds.

(To be continued).

ON CHROMEISEN, AND ON SOME OTHER ALLOYS.

By SERGIUS KERN, St. Petersburg.

(1). In my paper "On the Chrome-Iron Alloy," inserted in Chemical News, vol. xxxii., p. 136, I promised to communicate the results of some further experiments on the use of chromeisen in the manufacture of steel by the Siemens process.

Experiments proved that, by using chromeisen instead of spiegeleisen, extremely soft steel is obtained; rods made for experiments were very easily bent, even by hand. It is seen, from these attempts to replace spiegeleisen by chromeisen, that the use of the chrome-iron alloys is limited, and the steel obtained is for most purposes too soft for the manufacture of such materials as rails, axles, tyres, &c.

During some experiments with the chrome-iron alloys, a strange phenomenon was observed. It is well known that chromium is extremely hard, and scratches even hardened steel; meanwhile, an alloy was obtained which was malleable, and in a fresh state could be easily bent. It was also remarked that sometimes in opening the crucibles nothing but slag was found, but, in breaking the crucibles, the alloy was found to be in the bottom of them. That may be attributed to the corrosive properties of the liquid alloy, which often penetrated even through the bottoms of plumbago crucibles.

The above-mentioned alloy was analysed, and the following average composition was found:—

	Per cent.
Metallic iron	96·40
Metallic chromium	2·30
Carbon	traces
Lime, Silica	1·30
	100·00

(2). By melting a mixture of cast-iron, tin, and lead in the following proportions, a very liquid alloy is obtained:—

	Per cent.
Cast-iron	79·00
Tin	19·50
Lead	1·50
	100·00

The alloy has a very handsome appearance, and fills perfectly well the casting-moulds; thus it could be used for casting small articles. The alloy is to some degree malleable.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 255.)

The calculations which Helmholtz† has lately put forward concerning the respective ratio of bulk to resistance and to speed in ships and balloons are therefore of great value. According to him the speed of Dupuy's balloon nearly

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."
† Helmholtz, *Berl. Akad. Ber.*, 1873, 501.

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attained the maximum possible for its size. In order to proceed slowly against a fresh breeze, with the sources of mechanical power at present available, the volume of the balloon must be three and a half times larger than that of the largest ship of the line. This demands of the tissue with which the balloon is to be constructed a degree of strength scarcely possible. In fact the expectations of the inventors did not go beyond the hope of steering the balloon when the air is tranquil. If the screws or paddle-wheels are enlarged they must also be made thicker and stronger in order to preserve the necessary firmness. "We can only work sparingly with slowly-moving propellers of large surface, and to produce these of the requisite size without burdening the balloon too much will constitute one of the greatest practical difficulties."

With this sentence Helmholtz concludes his memoir, and the prospects to which he points fall very far short of the enthusiastic phophecies of such as are guided by their wishes rather than by sober scientific considerations.

The problem of steering balloons turns on three conditions—the production of balloons of the lowest specific gravity; the construction of propellers, light, but capable of resistance; and of sources of power at once light and capable of performing a high duty. In how far chemistry has prepared the way towards the fulfilment of the last condition, *e. g.*, by means of aluminium, the future must decide. The first condition she has accomplished ninety years ago, by means of hydrogen, as is now fully recognised.

Upon the consideration of hydrogen and oxygen should follow an account of the industrial applications of water. These, however, are so many-sided—not to say omnipresent—that they escape our reach. The most important will be considered in especial chapters.

The elements oxygen and hydrogen form, however, as is well known, a second compound, peroxide of hydrogen, H_2O_2, which has latterly begun to acquire a certain industrial importance.

Peroxide of Hydrogen.

In 1818 Thénard caused acids to react upon barium peroxide, and obtained solutions extremely rich in oxygen which they gave up with remarkable ease. He considered them as higher grades of oxidation of the acids employed, but soon perceived their true nature.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

November 27th, 1875.

Professor G. C. Foster, F.R.S., Vice-President, in the Chair.

The following candidates were elected members of the Society:—Professor Osborne Reynolds, M.A.; Professor H. J. Smith, M.A., LL.D.; Professor R. B. Clifton, M.A., F.R.S.; C. Busk; J. Thomson; J. W. W. Waghorn; W. Esson, M.A., F.R.S.; F. W. Bayly; and Professor R. W. Emerson MacIvor.

Professor Guthrie briefly described Dr. Kerr's recent experiments to show that glass, resin, and certain other substances exhibit a depolarising effect when under the influence of powerful electrical tension, and he exhibited the arrangement of apparatus employed in the research. He also showed certain experiments connected with the investigation.

Dr. Guthrie then made a communication on "*Stationary Liquid Waves*," in continuation of that which he made to the Society in June last. If water in a cylindrical vessel not less than 9 inches in diameter be agitated by depressing and elevating a flat circular disc on its surface at the centre, a form of oscillation is set up which the author terms "binodal." He finds that these fundamental undulations in an infinitely deep circular vessel are isochronous with those of a pendulum whose length is equal to the radius of the vessel; and further, a fact which is extremely interesting, that the motions of the pendulum and water keep together throughout their entire paths. An arrangement was exhibited for experimentally demonstrating these facts. To the upper end of a short pendulum with a heavy adjustable bob is attached a cardboard sector, in the plane of vibration of the pendulum. A silk thread attached to the edge of this sector carries a small paraffin disc, which rests at the centre of the surface of the water contained in a cylindrical vessel. The pendulum-length is adjusted until the motion of the disc is isochronous with that of the water when the two are not in contact. Two other forms of motion may be produced in cylindrical vessels, namely (1), by alternately compressing and extending opposite ends of a diameter, as in the motion of a bell (this gives two diametral nodes, at right angles to each other); and (2) by rocking the vessel, which gives a single diametral node. Each of these has its own period of vibration, the last being the slowest. They may be super-imposed on each other, and a rotation of the water, however great, does not interfere with their formation. In rectangular troughs a binodal and a mononodal wave-system may be established. The former is induced by raising and depressing a wooden lath at the middle of the surface, and the latter by tilting. Binodal vibration in a circular trough may be compared with a vibrating pair of triangular laths, and in rectangular troughs to the balancing of two rectangular laths. In this latter case, the nodes are at one-fourth of the trough's length from each end. Some discrepancies are met with when we compare times of vibration in rectangular troughs of various lengths, and these are due to a scraping action which takes place against the sides of the vessel. The result of the experiments on binodal motion in rectangular vessels is to show that the undulations are isochronous with the oscillations of a pendulum whose length is $\frac{2}{\pi}$ times that of the trough.

The chief points in connection with this subject to which the author referred as still requiring explanation are:—(1). Why are the motions pendular? (2). How is it that, in circular binodal motion, the times are identical with that of a pendulum of the given length? And (3), What is the mathematical connection between the individual motion of each particle and that of the mass.

Mr. Lodge thought that valuable results might be obtained by treating the mass of moving water as a pendulum, with two bobs oscillating about the node. This might be specially useful with small oscillations, when the surface is practically plane.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, October 28th, 1875.

John Pattinson, President, in the Chair.

The minutes of the last general meeting were read and confirmed. The Committee's report and Treasurer's statement were presented.

President's Address.

Gentlemen,—I have to thank you for the great honour you have again conferred upon me in electing me to be your President for the ensuing session.

In making the customary review of the work accomplished by our Society in the past year, it will be found, I think, that this will bear comparision with the work of most of the previous years of our existence as a society, not only as regards the number of papers read, but also as regards the importance and value of these papers.

Mr. John Morrison gave us a very able and interesting

paper on the "Manufacture of Caustic Soda," as carried on especially in the Lancashire works. Mr. Morrison's paper contains many practical details of great interest to the manufacturer, on a subject about which but little had previously been published. It may be mentioned incidentally here, that there has recently appeared in the *Journal of the Society for the Promotion of Scientific Industry*, a very exhaustive treatise on this manufacture, by Mr. George E. Davis,* and which contains a number of elaborate analyses of the materials in various stages of the process. It is strange that the manufacture of caustic soda, although commenced in several works on the Tyne, has never taken root with us and grown as in Lancashire. In many cases it has been abandoned, and at the present time only about 3000 tons per annum are made on the Tyne, whilst upwards of 50,000 tons are made in the Lancashire district. The question naturally suggested itself during the discussion on Mr. Morrison's paper, "Why does this manufacture flourish in Lancashire and decline in this neighbourhood?" The same materials used by the Lancashire makers are accessible to the Tyne makers; we believe the latter are as well skilled and energetic in their business; and we are as near as they are to some, at any rate, of the markets where caustic soda is consumed. It is somewhat humiliating to such of us as are analysts, to have to confess that the answer to this should be that "probably one of the chief reasons is on account of the differences in the tests of the chemists upon which the caustic soda is sold in the two districts." I have alluded to this subject on previous occasions, but I deem it of so much importance, that you must pardon me if I again call your attention to it, for I believe it is in this way that the chemical manufacturers of the Tyne are very heavily handicapped in the race with their competitors on the other side of the island. The same cause, moreover, affects not only the caustic soda trade, but also the larger and more important one soda-ash. Mr. Morrison states that "the Liverpool test usually ranges 1 to 2 per cent beyond the ordinary commercial one." This is notoriously true, and merchants have been known to make a profit by buying ash by the Tyne test and selling it by the Liverpool test. In a recent case which has come under my notice, a sample of caustic soda tested in Liverpool was certified to contain 60 per cent of soda. The identical sample tested most carefully in my laboratory was found to contain only 57·0 per cent! No notice was taken by the Liverpool chemist of the request by the buyer that the sample should be re-examined. I have been in correspondence with most of the Liverpool chemists, and they assure me that the same standard is adopted there as on the Tyne, viz.: that based on the assumption of the old chemists, that pure carbonate of soda contains 59¼ per cent of soda; and yet differences of from 1 to 3 per cent are constantly found between the Liverpool and Tyne tests! I need not tell you that the testing for soda is so simple an operation that there need be no difficulty in two chemists agreeing within a quarter of a per cent in their tests. Now, a difference of from 1 to 3 per cent in the test makes a difference of from about 4s. 6d. to about 18s. per ton in the price. This difference in price constitutes a fair profit in itself, and would sometimes enable the Lancashire maker to prosper whilst his Tyne fellow manufacturer would be losing money. I am afraid there are no means of remedying this state of things until the customers of soda-ash and caustic soda are made acquainted with the circumstances, and insist upon being supplied with the percentage of soda for which they pay. How this is to be done I leave the chemical manufacturers of the Tyne, who are chiefly interested, to decide.

Mr. N. Glendinning described at one of our meetings an ingenious apparatus he had devised for the absorption of gases in analysis. By a very simple arrangement the gases are made to pass in very minute bubbles through a considerable depth of liquid, and thus effective absorption is secured. The apparatus is found to be useful in testing the gases in the Deacon process of bleaching-powder making. With the various kinds of new plant now being constructed in our chemical works, many new forms of apparatus, and short simple modes of testing will be devised, and I hope other members will follow Mr. Glendinning's example, and bring them before the notice of our members.

A very able paper was read by our late president, Dr. Lunge, containing criticisms on certain remarks made by Dr. Angus Smith the Inspector of Alkali Works, on the effect of gases from chemical works on the health of the population in the neighbourhood, given in his report to the Local Government Board for 1873-4. Dr. Lunge, I think, succeeded in showing that, so far as statistics had been collated on this subject, they showed a lower death-rate in towns in the neighbourhood of chemical works than in other towns not so placed. Whether alkali fumes, however, are beneficial to health or not, they are certainly very unpleasant, and I am sure Dr. Lunge will agree with me that, on this account alone, it is desirable to limit their escape from our works to the very lowest possible amount.

A note was read at one of the meetings giving the results of an experiment made by our Secretary, to decide a point raised in a discussion at a previous meeting as to the preservation in blue and white glass bottles of the solution of arsenious acid used in testing bleaching-powder. It was found that the solution kept equally well in both kinds of bottles.

Mr. John Wallace read a paper "On Certain New Forms of Bunsen Burner." Mr. Wallace gave the results of several experiments he had made to determine the best proportions of air and gas to be used, in order to develop the greatest amount of heat. Various forms of burners were shown, devised by Mr. Wallace to attain this object, and also to prevent what is often found to be very troublesome in laboratories—the tendency of the flame to strike down when the gas is turned low. I believe Mr. Wallace has made some further improvements, and purposes favouring us with another paper on this subject.

Denayrouze's apparatus for working among poisonous gases was exhibited in action at one of our meetings. The circumstances under which such an apparatus would be useful, will suggest themselves to the mind of every one acquainted with chemical works, collieries, and other places where irrespirable gases are accumulated.

Lastly, Mr. Thomas Gibb favoured us with a useful paper "On the Manufacture of Spongy Iron." There is very little information published on this subject, and it is a great privilege, not only to this Society, but to the world at large, to have the benefit of Mr. Gibb's great practical experience on this subject.

Passing now from a report of our own progress to that of other bodies dealing with subjects of interest to us as chemists, I have to notice that the Committee appointed last year by the British Association, to report on the methods employed in the estimation of potash and phosphoric acid in commercial products (which Committee was asked for by the Glasgow Philosophical Society and by our own Society) has made a preliminary report from which it appears that the Committee has received a large amount of information from various chemists as to the methods employed, and expects to be able at the next meeting of the Association to recommend some correct and ready methods of analysis whereby exact and concordant results may be obtained. It is to be hoped that this may be the case. Meanwhile Mr. Ogilvie has recently published a very elaborate series of analyses pointing out a number of sources of error in what has hitherto been considered one of the most correct methods of determining the amount of phosphoric acid in manures—the oxalic acid and magnesium process.

The Bill introduced by the Government during the last session of Parliament to prevent the pollution of rivers,

* See Chemical News, vol. xxxii., p. 164 *et seq.*

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after being discussed in the House of Lords, met the fate of the "murdered innocents," and was withdrawn towards the end of the session. In framing the Bill the standards of purity suggested by the Royal Commissioners on this subject were not adopted, and the Government seem disposed to make the measure little more at present than one to prohibit the throwing of solid refuse into streams.

Closely connected with this subject is that of the disposal of the sewage matter of towns. How best to deal with this is still an unsettled question. None of the processes which have hitherto been tried are found to be successful in a pecuniary point of view. It has, however, been proved that by a combined system of irrigation and filtration, or of defecation and filtration, the effluent water from sewage can be made so pure as to be no longer a source of nuisance and at a comparatively small cost. This perhaps is as much as can be expected in dealing with refuse matter which has been diluted with about a thousand times its weight of water. The question naturally arises if the whole system of disposal of valuable manurial refuse by water carriage is not a mistake, and if it would not be better to keep these matters separate from the surface drainage and the washing waters of the house. The present system is, however, convenient and cleanly, and, now that we are used to it, will be difficult to alter.

(To be continued.)

NOTICES OF BOOKS.

Office for Referees, Assessors, and Experts, associated to meet the Requirements of the Acts of the Supreme Court of Judicature, and for the Sale of Food and Drugs Act recently brought into operation; also for the Audit of Accounts, Testing the Accuracy of the Reports of Public Analysts, the Settlement of Disputed Patents, and the Preparation of Models or Drawings.

Under this head, we have received a couple of circulars and an explanatory letter. The Associated Office seems to be formed for the convenience of members of the legal profession who may require the aid of experts of any of the classes above-named. Our only questions concerning the Association are, Will it promote the interests of science? And will it raise the status of competent and conscientious chemists, and serve to repress pretenders? If the "Office of Associated Referees" is likely to have this effect, it shall have our heartiest support; but, so far, we are quite unable to form any opinion. The Secretary and Manager of the "Office" are total strangers to us, and, though certain eminent men are said to be associated with the "Office," yet, as their names are not mentioned, we must suspend judgment.

Deutscher Färber Kalender für 1875.* Jahrgang 1. Leipzig: G. Weigel.

This work appears under the auspices of the editor of the *Muster-Zeitung*. It consists of two sections, the former of which is simply an ordinary almanac, with columns for the arrival and departure of "wares." We may here mention, for the benefit of readers of foreign works on dyeing, that the German word "waare," though it is the literal translation of the English "ware," has a totally different technical meaning. With us it signifies the drugs and chemicals employed in dyeing; with the Germans it denotes the pieces, yarns, &c., to be dyed.

The second part of the book is a collection of receipts, in which we are compelled to state that we see little which is at once novel and valuable. We are somewhat surprised to find the process for producing an orange on silks by means of nitric acid brought forward in a work of this class. The receipts for scarlet on woollen cloth are different from those now in use in English dye-houses, and, as far as our experience enables us to judge, certainly not superior. The authors are assuredly mistaken in supposing that scarlets are not often dyed with lac-dye. We find no mention of the use of borax, bicarbonate and silicate of soda, &c., to modify the tone of magenta. Nor have we discovered any notice of the hydrosulphite vat, or of the new colours of Croissant and Bretonnière.

The dyer, at the present day, operates almost as frequently upon mixed goods—say, of wool or worsted, with a cotton warp—as upon pure unmingled materials. As regards this important department, our authors appear to have no instructions to communicate.

It is to be hoped that future issues of the "Färber Kalender" will be richer in matter calculated to further the progress of the tinctorial arts.

* *German Dyer's Almanac.*

CORRESPONDENCE.

THE RIVERS' COMMISSION.

To the Editor of the Chemical News.

Sir,—From the sixth and final Report of the Rivers' Pollution Commission, which has recently been published, it appears that the Commissioners have not availed themselves of the modern improvements in water analysis, but have employed the method of Frankland and Armstrong, which, as is well known, is affected with so high an experimental error as to be perfectly illusory.

The strangest peculiarity in the report is the completeness of the demonstration of the untrustworthiness of the analytical methods employed by the Commissioners. The paper by Frankland and Armstrong, which was read to the Chemical Society in 1868, and which exhibited the experimental error of their process as being many times as great as the quantities to be measured, is re-published by the Commissioners.

Methods like Frankland and Armstrong's have a tendency to yield results in accordance with the expectation of the analyst, rather than with the real composition of the sample. This characteristic (which was not prominently displayed in the paper of 1868) has been brought out in a foot-note on page 505 of the Report. I quote from this foot-note.

"Since the above was written several improvements have been made in the process. The following test experiments show that it has now (1874) attained a still greater degree of accuracy, a statement which is further corroborated by the results of very numerous series of analyses of water supplied to London, given in the diagrams facing pages 261 and 262 of this Report. To 100,000 parts of a sample of water, rendered as nearly chemically pure as possible, 1·957 part of sulphate of quinine was added. The following data compare the quantities of organic carbon and organic nitrogen thus actually added to the water with those afterwards found in the two analyses:—

	Actually Present.	Found by Analysis.	
		I.	II.
	Part.	Part.	Part.
Organic carbon in 100,000 parts of water	0·857	0·9120	0·904
Organic nitrogen in 100,000 parts of water	0·100	0·0996	0·098

"In another instance, 0·9785 part of sulphate of quinine was dissolved in 100,000 parts of water, and 0·050 part of nitrogen calculated, and 0·047, 0·048, and 0·048 found; and in a third instance 0·09785 part of sulphate of quinine taken, calculated to contain 0·005 part of nitrogen, the results of experiment being 0·006 and 0·005."

Now, by a happy mischance, Dr. Frankland's calcula

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tions of the nitrogen are miscalculations, and in the above he has afforded us an opportunity of learning by actual trial whether the result accords with the anticipation of the analyst, or with the composition of the sample.

If the reader will take the trouble to calculate the nitrogen contained by 1·957 parts of sulphate of quinine he will find it to be 0·1469, and not 0·100, as Dr. Frankland represents it. In 0·9785 part of sulphate of quinine the nitrogen is 0·0734, and in 0·09785 the nitrogen is 0·0073.

Thus we see that when 0·1469 nitrogen was really present, and when 0·100 nitrogen was supposed by Dr. Frankland to be present, his analysis exhibited a close approximation to 0·100, and similarly in the two other cases.

It would be hard to imagine a more striking exemplification of the utter worthlessness of an analytical method, and the Royal Commissioners are to be congratulated on having furnished us with it.—I am, &c..

J. Alfred Wanklyn.

November 27, 1875.

DISEASED MILK.

To the Editor of the Chemical News.

Sir,—Mr. Blyth's paper on the milk of cows suffering from foot and mouth disease cannot fail to interest not only Public Analysts, but also the consumers of milk generally. The fact that children, and even adults, suffer from analogous ailments, which may be traced to the consumption of milk drawn from cows attacked by this disease, is every day pressing more and more upon our notice.

Through the indefatigable zeal displayed by the Medical Officer of Health for this town in thoroughly sifting this matter, I have had occasion to examine no less than one hundred and twenty-seven samples of milk from cows suffering from the "foot and mouth disease" during the past six months.

Mr. Blyth gives the *post mortem* appearances of a calf which died with extreme suddenness after suckling its mother. These suggest that the animal was already suffering from the disease itself, otherwise the apthous patches would not be present.

I have found, almost invariably, that the milk of the cow, even on the first day of the attack, differs from healthy milk; and the various appearances characteristic of this disease are often observable on the first or second day, and not unfrequently remain for fourteen or twenty-one days. The tendency of the milk globules to aggregate, as the author remarks, is one of the principal signs of this disease, and one which is never absent. This disposition of the fat globules to aggregate is, in my opinion, due to he casein being in a modified form. The fat globules are much larger than in healthy milk, and during the advanced stage of the disease rise to the surface not as cream, but almost pure butter fat. The film which envelops the particles of fat presents a glairy, mucous-like appearance, and is intensely refractive.

The affinity of this matter to envelop and retain the particles of fat equally distributed throughout the milk is so weak that it is only necessary to agitate a strongly affected sample for a few minutes to enable one to obtain, from a pint of milk, a lump of butter weighing an ounce or more. The casein, under these conditions, remains unaltered, and in many instances is with difficulty coagulated by dilute acids.

Pus cells, granular cells, epithelium, and animal matters are observed more or less throughout the continuance of the attack, but are present in larger quantity during the full development of the disease. I have been unable, with any degree of certainty, to detect either bacteria or vibriones, and I am inclined to think that the bodies somewhat resembling these are altered fat globules or animal matters.

With regard to the composition of the milk of cows suffering from this disease, the result of my experiments differ entirely from those of Mr. Blyth.

Immediately the animal is attacked the secretion becomes less in quantity, and when the milk glands are seriously affected so acute is the action of the accompanying fever that apparently a portion of the normal water of milk is retained, and we find, in consequence, 20 or 25 per cent of solids containing as much as 10 per cent of fat. Moreover, the proportion of casein to lactin is augmented rather than diminished. It is true, however, that milk drawn from animals seriously affected is almost always strongly acid, and a portion of the lactin may have been lost by acid fermentation. This was not the case with the samples, the analyses of which are given below. In many instances the milk secretion does not appear to be affected to any considerable extent, and the composition of the milk does not strikingly differ from that of healthy milk.

I have found, almost without exception, that the proportion of fat in diseased milk is as great, and often much greater, than in healthy milk.

I am indebted to Mr. Moir, M.R.C.V.S, for samples obtained by himself direct from the cows, and his observations entirely accord with mine.

The following analyses are selected from a great number, and will show the composition of the milk according to the state of the disease:—

A. Third day of duration; virulently attacked.
B. Fifth " " " "
C. Fourth " " strongly "
D. Fifth " " " "
E. Third " " slightly "
F. Sixth " " " "

	Water.	Fat.	Casein.	Lactin.	Ash.	Total Solids.
A.	76·40	9·91	8·01	4·69	0·99	23·60
B.	78·38	8·26	8·22	4·25	0·89	21·62
C.	81·80	7·01	5·92	4·47	0·80	18·20
D.	82·39	4·60	6·00	6·20	0·81	17·61
E.	84·04	3·86	5·43	5·94	0·73	15·96
F.	86·87	4·01	4·03	4·39	0·70	13·13

In some few instances, where the animals were certified as suffering from a severe chill in addition to the disease, the milk was very poor, the fat falling to 2 per cent, and the casein and lactin 3¼ and 5 per cent respectively. I find the ash low in all instances when compared with the total solids.

The composition of diseased milk differs greatly, and the more the udder participates in the disease, or is affected by it, the larger will be the percentage of solids present in the milk.

J. W. Thomas.

Cardiff, November 23, 1875.

REFORM IN THE MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

Sir,—The above "sensational heading" led one to hope that it was all coming at once—that some lucky fellow had indeed hit upon the one method for profitably extracting this important article from the atmosphere. But, alas! no such luck, for the letters of "Onward" admit of no reply so fitting as the first four lines from E.H. (Chemical News, vol. xxxii., p. 204), implying that "Onward" ought to "move on," or, in other words, reform at home first. Or, in view of "Onward's" last letter, one might reasonably expect that in his next letter the name and address of the "large party" would appear as the only maker of sulphate of ammonia, and that the now familiar cognomen of "Onward" would be changed into "Advt."

Be this as it may. "Onward" says white sulphate of ammonia cannot be made from pyrites acid. I can tell him, as a fact, that sulphate (I use the word advisedly) of ammonia—perfectly white and free from sulphocyanides—can be made, and has for years been made (since 1857 by myself), from sulphuric acid manufactured from various kinds

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of sulphur ore, and is now daily made from Spanish pyrites acid.

It will be readily admitted that having obtained white sulphate containing the 24 per cent, a little careful manipulation will produce a "good grey," or an "orthodox hue," or a "brownish tint," or "black as my hat," as your correspondent, "Mid-day," has it. Although I daily make white sulphate, I quite agree with the last paragraph of "Mid-day's" letter as practical and to the point. I have never tried the "white sand" experiment. I wonder if arsenic is precipitated by sand? There may be some intelligent practical chemists who would be curious to learn what methods of "analyses for ammonia" was employed to detect the large quantity of this certainly strange material in this "good grey," which was so "unexceptionable in appearance." Perhaps it was really a "sand glass." —I am, &c.,

G. J. S.

CHEMICAL NOMENCLATURE.

To the Editor of the Chemical News.

Sir,—If the cause assigned by "Amateur" to the dearth of chemical students in this country be true, it remains for us only to weep over the little souls that can be dismayed by an array of words, and admire, while we envy, the superior courage of the youth of other lands who are not so easily daunted. This is the more to their credit as the mysterious horrors of such "crack-jaw words" are greatly enhanced by the necessity of pronouncing them with the "accent." But this is absurd. "Amateur" speaks of "would-be students" taking up a book, and finding in it such words as "polymerism," "paramido-ortho-sulpho-toluolic acid," &c., relinquishing the pursuit of the science on which that work is a treatise. In the first place, I do not think that organic chemistry is the first pabulum offered to the mental palate of the neophyte.

On the contrary, every effort is made to prepare him for the shock. His nerves are strengthened by gentle instalments of Science Primers and Pepper's Playbooks. He is then introduced, warily and discreetly, to some more advanced inorganic volume. When this (in which already poly-syllabic words begin to loom) is duly digested, such a work as Armstrong's "Organic Chemistry," perhaps, is playfully brought under his notice, and thus he launches, well prepared, into the sea of C's and H's, amidos and paramidos, orthos and metas, and isos, which seem to produce so great an impression on "Amateur." Organic chemistry is not intended for a novice. There would be as much sense in a "would-be" student of harmony declining to undertake the pursuit of that melodious science because he lighted on some such word as semi-demi-semi-quaver; or in an embryo mathematician relinquishing his studies because he saw in an Euclid "semiparallelopiped" (I also quote at random), as in the case mentioned by "Amateur." I do certainly not think that the paucity of chemical disciples is to be sought for in that direction.

With regard to a work on organic chemistry where a good classification may be found, I do not think "Amateur" can do better than consult the Text-Book of Science, "Organic Chemistry," by Dr. Armstrong, or the little "Manual of Chemistry," by Fownes. A new edition of Miller's "Organic Chemistry" will shortly appear, and it would be hard if, in one of these works at least, "Amateur" did not find what he wants.—I am, &c.,

C. Leopold Field.

Hither Green Lodge, Lewisham.

CHEMISTRY IN SWANSEA.

To the Editor of the Chemical News.

Sir,—Perhaps you will allow me to make a few remarks upon your article (Chem. News, vol. xxxii., p. 251) entitled as above.

1. A certain portion, but not the most influential, of the local press has—for reasons of its own—lost no opportunity of speaking disparagingly of Mr. Morgan, and the post he fills.

2. Mr. Morgan, while giving his evidence in the "oil trial," got so thoroughly nervous and utterly confused that he had but rather a dim idea of what he was talking about. Consequently his answers were very different to those he would have given in calmer moments.

3. The sight of the Public Analyst in a witness-box, and thoroughly bewildered, was a most pleasing spectacle to certain disinterested friends of his, who thought it a rare opportunity for making him say what nonsense they chose, in the most grotesque manner possible.

4. Mr. Morgan denies that he used the term "mineral oil" in the evidence he gave.

5. Other gentlemen, who were present in the Court at the time, also emphatically deny Mr. Morgan used the above words. Some of these gentlemen are public men of position in the town.

It seems to me, therefore, that there are two sides to this, like every other question, and that Mr. Morgan has been very hardly dealt with. Allowing the version of the evidence which has gone the round of the press to be a correct one—are they not "hard lines" which condemn a man unfit for his post just because in a fit of bewilderment he made a statement which was absurd?

Notwithstanding all that has been made of this unfortunate affair, most people still think the Public Analyst for Swansea is fully competent to perform the duties of his office.—I am, &c.,

J. L. Davies.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 19, November 8, 1875.

Memoir on the Measure of Affinities in the Mutual Reactions of Two Solutions, taking the Electromotor Forces as Bases.—M. Becquerel.—The author recapitulates the conditions necessary for the production of electro-capillary currents, and the chemical actions to which they give rise. After describing certain experiments, he announces his intention of giving the results of experiments made to determine the values of the affinities, in virtue of which the liquids of organised bodies react upon each other so as to maintain life in all their component parts.

Alcohols which Accompany Vinic Alcohol.—M. I. Pierre.—The author points out the injurious effects of the propylic, butylic, and amylic alcohols.

Exhaustion of the Soil by Apple Trees.—M. I. Pierre.—The author calculates that in a life of sixty years an apple tree removes from the soil 26 kilos. of nitrogen, equal to 5200 kilos. of farm-yard dung. To maintain the soil in condition, therefore, about 80 kilos. of dung ought to be annually given per tree during the fifty years that it is in bearing.

Observations on the Foregoing Paper by M. P. Thénard.—The author calls in question the views of M. Pierre.

Separation of Mixed Liquids, and on New Maximum and Minimum Thermometers.—M. E. Duclaux.—This memoir treats of the conditions governing the separation of a homogeneous mixture of two liquids into two layers when any external circumstance—*e.g.*, a fall of temperature—intervenes to disturb the solution, and transform it into a double mixture. In these conditions the composition of the two layers which are formed remains

constant whatever may be the initial composition of the liquid, only varying in their relative volume. The same fact occurs in ternary mixtures when—which often happens—one of the constituent liquids does not take part in the separation, and remains in the same degree of concentration in each of the two layers produced, as in the primitive liquid. The only new phenomenon is that the presence of this third liquid modifies the molecular relations of the two former, rendering them, for instance, soluble the one in the other, serving them for a tie of union, and thus permitting them to manifest the same phenomena as above. They distribute themselves, when the original equilibrium is destroyed, into two layers of almost constant composition, among which the third liquid is uniformly divided. From this constancy of composition it follows that it is always possible to set out from an initial mixture, such that, under the action of a fall of temperature, it is divided into two strata of the same volume; and experience shows that the variation of temperature necessary for obtaining a phenomenon so well characterised is extremely small—much less than one-tenth of a degree. For instance:—A mixture of 15 c.c. of amylic alcohol, 20 c.c. of common alcohol, and 32·9 c.c. of water, forms, at 20°, a very unstable molecular group, which on the least fall of temperature is resolved into two strata almost equal. Traces of common salt, of chloride of calcium, of various other soluble salts, and of vapours of chloroform, produce the same effect. The same result is obtained on adding a drop of water, or of amylic alcohol, which do not enter into solution because the mixture of the two liquids is saturated. This leads to the construction of a very simple maximum and minimum thermometer. The mixture given above, limpid and homogeneous above 20°, becomes turbid at this temperature, and is divided into two equal layers. Other mixtures, with more or less water, exhibit the same phenomenon at other temperatures. These instruments have the inconvenience of requiring a special mixture for every temperature; but they are easy to construct, economical, solid, and dread neither shocks nor the influence of pressure.

Process for Separating Cholesterin from Fatty Matters.—M. A. Commaille.—The author saponifies with caustic soda, and after cooling and dissolving the soapy mass in water he agitates with ether. This liquid, when separated and evaporated, yields numerous flakes of cholesterin.

Determination of Caffeine, and on its Solubility.—M. A. Commaille.—The author operates upon 5 grms. of powdered coffee, passed through a sieve of silk, No. 60. The powder is intimately mixed with 1 grm. calcined magnesia. With this mixture he forms a paste, almost solid, which is left for twenty-four hours, when it becomes yellow, and then green in contact with the air. It is spread then upon a saucer placed upon boiling water. In a little time we have a solid mass, which is triturated and sifted. This green powder is placed in a small balloon and treated, as Lieventhal directs, three times with anhydrous chloroform (100 grms. in three applications suffice for the exhaustion). It is boiled each time for half-an-hour, by plunging the flask into hot water. The chloroform flows back into the flask by using a Liebig's condenser filled with water. The filtration of the cold chloroform is very rapid. The liquid, perfectly colourless, is received in a flask having a neck of the same diameter as that which has been used in refrigerating, in order that it may easily fit the stopper of the refrigerator. The chloroform is then distilled off. When the chloroform is evaporated there remains a substance almost colourless and very bulky, consisting of fatty and waxy matters, and of caffeine. Water is poured in along with 10 grms. of broken glass, previously washed in hydrochloric acid, and reduced to a powder as fine as what is used for drying up ink. The mixture is heated, with constant stirring. When the water boils the flask is closed with linen, and is well shaken. The liquid is then thrown upon a moistened filter, and received in a tared capsule. By repeating this process three times all the caffeine is taken up, and on evaporation is found white and crystalline, and may be weighed when perfectly dry. 100 grms. of the liquids below dissolve—

	At 15° to 17°.	At 100°.
Chloroform	12·9700	19·020
Alcohol (85°)	2·3000	—
Water	1·3500	45·550
Pure alcohol	0·6100	3·120
Ether (common)	0·1900	—
Carbon bisulphide	0·0585	0·454
Anhydrous ether	0·0437	0·360
Petroleum essence	0·0250	—

Researches on the Inversion of Cane-Sugar by Acids and Salts.—M. G. Fleury.—The author has studied the progress of inversion produced by different acids employed in equivalent weights. He gives tables representing the percentages of sugar transformed in equal periods of time. There is no apparent relation between the speed of inversion and the atomic weights of the bodies which produce it: thus arsenic acid acts more rapidly than phosphoric acid. If different proportions of sugar are employed with the same acid, the time required for its complete inversion is constant, and that within narrow limits. If the dose of acid is varied the duration of the phenemenon is abridged as the weight increases. Experiment shows that glucose and levulose—products of the decomposition of cane-sugar—have no tendency to recombine, at least in presence of the acid which has determined their separation.

Comparison of the Unipolar Excitations of the same kind; Influence of the Increase of the Current of the Battery upon the Value of these Excitations.—M. A. Chauveu.—Not adapted for abstraction.

Central-Blatt für Agrikultur Chemie, Heft 9, September, 1875.

Researches on the Ripening of Grapes.—Cerletti.

Process of Germination, and on the Presence of Crystalline Sugar in Sprouting Cereals.—Gotthold Kühnemann.—From *Ber. der Deutsch. Chem. Gesell.*, 1875, No. 4, p. 202.

Experiments on the Transformation of Asparagin in Plants.—M. Mercadante.—From *Ber. der. Deutsch. Chem. Gesell.*, 1875, No. 11, p. 823.

Crude Fibre of the Gramineæ.—A. Stutzer.—See *Ber. der Deutsch. Chem. Gesell.*, 1875, No. 8, p. 575.

Constitution of Poplar and Pine Wood.—F. Beute.—*Ber. der Deutsch. Chem. Gesell.*, 1875, No. 7, p. 476.

Evolution of Hydrogen, and the Formation of Ammonia by Fungi.—F. Selmi, G. B. Ercolani, F. Sestini, and G. Del Torre.—The larger fungi evolve hydrogen as well as the mould-plants, and chiefly on the side turned away from the light. A small quantity of it combines with the nitrogen of the air to form ammonia, especially in places where there is no free circulation of air.

Researches on the Vital Process of Fungi.—M. Muntz.—From *Comptes Rendus*, 1875, No. 3, p. 176.

Comparative Merits of the Varieties of Maize.—Prof. G. Wilhelm and A. Mell.

Les Mondes, Revue Hebdomadaire des Sciences, No. 8, October 21, 1875.

The Academy of Sciences of St. Petersburg has published a chronological *resumé* of its *Transactions* for the years 1873 and 1874.

The French Association for the Advancement of Science has concluded its fifth meeting at Nantes.

No. 9, October 28, 1875.

In this issue we find the discourse delivered by M. Dumas on the death of Sir Charles Wheatstone.

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No. 10, November 4, 1874.

Waterproof Tissues and Paper.—Bichromate of potassa has the property of rendering glue and gelatine insoluble in water. Thus paper, and stuffs of cotton, linen, or silk, if once coated with this insoluble glue, become perfectly impervious. To render glue insoluble it is sufficient to add to the water in which it is dissolved 1 part of bichromate to 50 parts of gelatine. The addition is only made at the moment when the liquid is to be used. The process is conducted in full daylight. The Japanese make their umbrellas with paper prepared in this manner.

M. Reimann's Farber Zeitung, No 41, 1875.

The patent colours of Croissant and Bretonnière are offered by a new establishment under the name "sulfin colours."

No. 42, 1875.

In this issue is a scheme for dyeing plush-black with white tips, by brushing over with a reserve made of stearine and resin melted together. After this composition has hardened, the plush is dyed in the cold, and the reserve paste subsequently removed in a soap-beck at 50° R.

There are receipts for silk and jute dyeing which present no remarkable feature.

MISCELLANEOUS.

The Royal Society.—Tuesday, being St. Andrew's Day, the anniversary meeting of the Royal Society, as required by their charter, was held. The President, Dr. Hooker, began his address with a few remarks on the large number of eminent Fellows whose names appeared in the death-list of the past year, and then gave a summary of the numerous measures for "the improvement of natural knowledge" undertaken by the Society. These comprise the publication of papers in the *Philosophical Transactions* in a separate form; preparation of additional volumes of the "Catalogue of Scientific Papers;" the labours of committees in connection with the Transit of Venus Expedition, and the researches of naturalists in Kerguelen and Rodriguez; the Eclipse of the Sun Expedition to Siam, the Polar Expedition, the voyage of the *Challenger*, and of the committee appointed to consider the suggested modification of the regulations under which candidates are elected into the Society. The auditors' report showed that the pecuniary resources of the Society were in a satisfactory condition, and Dr. Hooker mentioned the bequests made to the Society by the late Sir C. Wheatstone and Mr. H. Dircks. The medals were then presented—the Copley medal to Dr. Hofmann, a Royal medal to Mr. Crookes, and a Royal medal to Dr. Oldham (at present in India), through Professor Ramsay. The proceedings terminated with the election of Council and officers. For the ensuing year, the following gentlemen were elected:—

President—Joseph Dalton Hooker, C.B., M.D., D.C.L., LL.D.

Treasurer—William Spottiswoode, M.A., LL.D.

Secretaries—Professor George Gabriel Stokes, M.A., D.C.L., LL.D.; Professor Thomas Henry Huxley, LL.D.

Foreign Secretary—Professor Alexander William Williamson, Ph.D.

Other Members of the Council—Professor J. Couch Adams, LL.D.; Major-General John T. Boileau; Edward Viscount Cardwell, F.G.S.; Warren De La Rue, D.C.L.; Capt. Frederick J. O. Evans, R.N., C.B.; Edward Frankland, D.C.L.; Albert C. L. G. Günther, M.A., M.D.; Professor T. Wharton Jones, F.R.C.S.; Joseph Norman Lockyer, F.R.A.S.; The Rev. Robert Main, M.A.; Professor Daniel Oliver, F.L.S.; Professor Edmund A. Parkes, M.D.; Right Hon. Lyon Playfair, C.B., LL.D.; William Pole, C.E., Mus. Doc.; The Rev. Bartholomew Price, M.A.; Warington W. Smyth, M.A.

The Anniversary Dinner was held at Willis's Rooms, Dr. Hooker in the chair, supported by the Marquis of Salisbury, Lord Cardwell, Mr. W. H. Smith (of the Treasury), the Right Hon. Robert Lowe, Mr. Farrer, Admiral R. Hall, Mr. Lyon Playfair, the City Chamberlain, Mr. W. Spottiswoode (Treasurer R.S.), Professors Stokes and Huxley (Secretaries R.S.), Sir Charles Shadwell, Admiral Richards, Capt. Evans, Hydrographer-General Strachey, Sir J. Grant, Sir B. C. Brodie, Dr. Hofmann, Mr. Crookes, Professor Ramsay, Sir A. Armstrong, and a large number of the Fellows of the Society and their friends.—*The Times.*

MEETINGS FOR THE WEEK.

MONDAY, Dec. 6th.—Medical, 8.
— Society of Arts, 8. Cantor Lectures: "On the Discoveries and Philosophy of Liebig, with Special Reference to their Influence upon the Advancement of Arts, Manufactures, and Commerce," by Dr. Thudichum.
TUESDAY, 7th.—Civil Engineers, 8.
— Zoological, 8.30.
WEDNESDAY, 8th.—Society of Arts, 8. "On the Mode of Levying the Sugar Duties in France, and its Influence on the Sugar Industries of Great Britain," by Prof. Leone Levi, F.S.S., &c.
THURSDAY, 9th.—Royal, 8.30.
— Royal Society Club, 6.30.
FRIDAY, 10th.—Astronomical 8.
— Quekett Club, 8.
— Anthropological Institute, 8.
— Society of Arts, 8. Special Lectures: "Industrial Pathology, or the Influence of Certain Injurious Occupations on Health and Life," by Dr. B. W Richardson, M.D., F.R.S. (Lecture II.)
SATURDAY, 11th.—Physical, 3.

TO CORRESPONDENTS.

Fair Play.—We have heard from Mr. Morgan privately, and shall probably refer to his case in our next issue. Mr. Morgan's cause would profit little if left to your advocacy. Invective is not explanation.

"Beet" and "Cane."—It is unnecessary to publish your letters. Mr. Stewart has admitted the charge of plagiarism, and we can devote no more space to the subject.

The Committee of the Fund now being raised for the Family of the late Dr. SCHENK, F.C.S., begs to acknowledge the following sums, received since the 23rd instant:—

Previously acknowledged, £345 4s.

Prof. Dewar	£1 1 0	P. T. Main	£1 1 0
R. Apjohn	1 1 0	Dr. Schunck	5 0 0
F. Ritchie and Sons ..	2 0 0	David Howard	2 2 0
Dr. Alfred Hill	1 1 0	Miles H. Smith	2 2 0
H. G. Madan..	1 0 0	A. P. Price	2 2 0

The Committee will gladly receive further contributions, which the Treasurer will acknowledge by post.

ALFRED TRIBE, Hon. Sec.

Royal Institution, London, W.,
November 30th.

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THE CHEMICAL NEWS.

Vol. XXXII. No. 837.

ON NOXIOUS AND OFFENSIVE TRADES AND MANUFACTURES,*

WITH ESPECIAL REFERENCE TO THE BEST PRACTICABLE MEANS OF ABATING THE SEVERAL NUISANCES THEREFROM.

By H. LETHEBY, M.B., M.A., &c.;

Professor of Chemistry in the College of the London Hospital; late Medical Officer of Health and Public Analyst for the City of London; and President of the Society of Medical Officers of Health.

(Continued from p. 263).

It may be interesting to know that the approximative yield of the several products per 1000 gallons of coal-tar is as follows:—

Crude and light oil, sp. gr. 0·940 to 0·970	from 24 to 40 gals.		
Creosote oil	„ 1·060 „ 1·070	„ 120 „ 180	„
Anthracen oil ..	„ 1·080 „ 1·095	„ 100 „ 160	„
Pitch which melts at 176° F.		3·2 to 3·6 tons.	

These products are again submitted to further operations for the purpose of getting benzol, toluol, light burning and solvent naphthas, carbolic and cresylic acids, creosote for fuel and for timber, and anthracen; but the processes are not generally offensive, and therefore need not engage much of our attention, although a brief outline of them may be useful. The light oil is re-distilled from stills with steam jackets or with closed coils, or by blowing steam into it. That which flows up to a gravity of 0·940 is put aside for benzol and solvent naphtha, and the remainder is used for carbolic acid. The naphtha thus obtained is purified by treating it with strong sulphuric acid, after which it is washed with lime water, and distilled for benzol and solvent naphtha. The heavier naphtha and the first runnings of creosote are washed with a solution of caustic soda for carbolic acid, which is subsequently separated from the alkali by neutralisation with acid; and the green anthracen oil is allowed to stand until quite cold, when the crude anthracen separates from it in granular particles. These are strained off through canvas bags and pressed in hydraulic or screw presses, whereby the crude anthracen of commerce is obtained. The approximative yield of each of these several products is:—

From crude naphtha and light oil from ..	6 to 10 per cent	tar acid.
	20 „ 28 „	benzol.
	10 „ 15 „	solvent naphtha.
Creosote oil ..	10 „ 15 „	carbolic acid, &c.
Anthracen oil ..	10 „ 12 „	crude pressed anthracen.

For the purpose of increasing the yield of anthracen with a large admixture of chrysen the distillation of the pitch is sometimes carried on until a spongy coke remains in the still, and under these circumstances the acridity of the evolved vapours is most offensive, and requires the utmost attention to prevent their becoming a nuisance to the neighbourhood. The main points, therefore, to be observed in the conduct of works of this description are:—

1. The transport and storage of the coal-tar in air-tight tanks or vessels guarded with boxes containing hydrated oxide of iron.

2. The proper construction of the primary receiver of the products of distillation, so that it may freely deliver them by special pipes to their respective receivers, and at the same time convey offensive non-condensable products to the scrubbers and purifiers.

3. The passage of the offensive non-condensable gases and vapours to a scrubber charged with a douche of cold water, then to an oxide of iron purifier, and thence to a tall chimney shaft.

4. The proper cooling of the pitch in air-tight vessels before it is allowed to reach the external atmosphere, and the ventilation of these vessels through the scrubber and purifier before mentioned.

5. The use of a fan or other exhausting power, so as to draw all the noxious gases and vapours from the stills, the pipes, the receiver, and the pitch den into and through the scrubber and purifier before mentioned.

The production of paraffin oil from cannel coal, and the distillation of the crude tar, as well as the distillation of petroleum and Rangoon oil, requires like precautions, though not to the same extent, as the products are not nearly so offensive as in the case of coal-tar products.

Dead oil or creosote is largely employed for preserving timber; but unless there is great carelessness in the management of the operations they are not offensive. The process is conducted in the following manner:—The timber to be creosoted is placed in iron cylinders of great strength and capacity; and when the end opening is closed and well secured with screws, the interior of the cylinder is exhausted by means of an air pump until there is a vacuum of about 5 inches of mercury. This is maintained for nearly half an hour, during which time the contents of the cylinder are heated by steam pipes. In this manner the air and moisture of the wood are drawn out of it, when dead oil is allowed to run into the cylinder until it is full. The heat is continued, and pressure is put upon the contents of the cylinder until it reaches to from 100 to 150 lbs. upon the square inch. This is maintained for many hours—the time varying from four to twelve hours, according to the nature of the work; in most cases the amount of creosote absorbed by the wood ranges from 40 to 50 gallons to the load of 50 cubic feet. The oil is then run out, and when sufficiently drained the timber is ready for delivery. Hardly any precaution is necessary beyond that of preventing the unnecessary escape of creosote oil and vapour.

Dead oil is also used as fuel, and there are two ways in which it has been successfully employed. In one case the oil is converted into vapour in a specially contrived boiler, and the vapour is burnt as fuel. In the other the creosote is delivered from a jet immediately over a steam jet, and as the creosote trickles down from the upper jet it meets the blast of steam which blows it as a fine spray upon a bed of glowing cinders or ashes. In this manner it produces a sheet of flame of great heating power. A ton of creosote, which is about 210 gallons, is equal to about 2 tons of ordinary coals; but the management of the jet or stream of creosote is rather a delicate operation, as an excess of the oil produces an immense volume of smoke, with the acrid irritating odour of the unburnt oil.

Before leaving the subject of these hydrocarbons, I may state that the *melting of pitch and asphalte* for the production of materials suited for the making of asphalte pavements, &c., is in the generality of cases a very offensive operation. All sorts of pitchy matters, as the residuum of paraffin oil (technically called "shellgrease"), Trinidad bitumen, various natural asphaltes, and coal-tar pitch are melted in small iron boilers set over naked fires. The boilers are but loosely covered, and during the melting and mixing, to produce the material called "bitumen," large volumes of irritating and offensive vapours escape into the air. The bitumen thus produced is, in some cases, again heated with powdered asphalte in specially constructed boilers having a mixer moved by machinery; and in this case offensive vapours are freely evolved. The charge when thoroughly incorporated and melted is called "mastick," and is drawn off into pails, and cast in moulds for use where the pavement is to be laid. All these operations should be conducted in closed

* A Paper read before the Society of Medical Officers of Health. Communicated by the Author.

boilers, which should be ventilated by a fan through a scrubber prior to its entrance into the chimney shaft.

The clarification of oil for burning and other purposes is generally effected by means of sulphuric acid, which is well stirred into it. After the black flocculi, formed by the action of sulphuric acid upon impurities, have subsided, the oil is further clarified by means of water and steam, the latter being blown into it until it reaches a rather high temperature; and during this part of the operation the oil is kept in gentle agitation by means of stirrers so as to favour the separation of the oil from water and other impurities. In the case of rape or colza oil, the vapours which are given off are disagreeable and acrid, like mustard, while those of linseed and other oils are also offensive though in a less degree. Cotton oil is refined by means of a solution of caustic soda, and this also, when subsequently heated by steam, is offensive. The remedy in each case is the carrying on of the operations in closed vessels, ventilated to the furnace fire.

The distillation of oils and fats for the production of stearic, margaric, palmic, oleic, and other fatty acids is effected by means of sulphuric acid and superheated steam. The melted fat is run into vats or boilers, where it is heated to a temperature of about 240° F. At this temperature it receives a dose or charge of strong sulphuric acid, delivered into it as a fine spray, or through perforated copper trays. All this time it is kept in continual agitation by means of stirrers, and this is prolonged for about an hour, during which time a little sulphurous acid and acroleine escape. When the fat acquires a dirty greenish tint the "saponification," as it is called, is complete. Boiling water is then run into the mixture and steam blown through it for about four hours; after this it settles for a couple of hours, and the acid watery portion is run off. It is washed a second time with hot water and steam, and when clear it is delivered into the stills for treatment with high pressure superheated steam—the pressure being about 50 lbs. on the inch, and the temperature about 500° F. At this temperature and pressure the fatty acids are distilled over, and are collected in a series of condensers, ending in a worm set in cold water. The first condenser delivers the greater part of the fatty acids with but little water, the second more water and less acid, and so on to the end, where water is the chief product. The water contains glycerin, and the residuum in the stills is a sort of pitch, which is used by the asphalte makers.

In these operations sulphurous acid and acroleine are evolved, so as to be offensive to the neighbourhood, unless they are conveyed from air-tight apparatus into the furnace fire.

Oil boiling for making varnishes, linoleum, leather-cloth, printer's ink, and black japan, is a very disagreeable operation, and requires to be conducted in boilers, from which the fumes pass into the furnace fire to be destroyed.

Varnish making and rosin distilling are also offensive operations, and necessitate the destruction of the acrid organic vapours by carrying them to the furnace fire, or to fires placed at the outlet of hoods which cover the pans. In cases where inflammable spirit is used to a large extent in certain manufactures, as in making American cloth, the difficulty of dealing with the vapour is exceedingly great, as it is dangerous to pass it through a furnace fire for fear of explosions. In one factory with which I am acquainted, the quantity of petroleum spirit used daily in the thinning of the oil for the colours is not less than 140 gallons—all of which is daily evaporated from the cloth in the drying room, which is gradually raised to a temperature of 130° F., at which it is kept for six hours during the drying of the colours. In these cases it is best to ventilate the room freely by special shafts communicating with the chimney at a point where the vapours are not likely to be fired.

Fat melting, bone boiling, tripe dressing, and *the cooking of sheep's heads, bullocks' cheeks, livers, and feet,* as well as the *boiling of shell fish, lobsters, and crabs,* are all offensive operations, and require to be conducted in closed coppers ventilated by special flues, which carry the organic vapours into the fires beneath them.

(To be continued)

NOTES ON A VISIT TO CHEMICAL WORKS IN FRANCE IN THE SUMMER OF 1875.*

By R. C. CLAPHAM, F.C.S.

During the past summer I had occasion to pay a visit to France, and I took the opportunity of making enquiries about, and personally visiting some of the large industrial works there. To-night I propose to read to the members a few short notes, mostly made on the spot, specially referring to the soda manufacture in France. This industry is interesting to us in this locality from various points of view. It is to France that we are indebted for the process now universally adopted for making soda in England, and for Gay-Lussac's important invention for saving nitrate of soda, and for many other chemical inventions of great practical utility. In a paper read before the members in 1867, I stated that not many years passed away after the establishment of the first soda works in Paris, in 1794, before our own townsman, the late Mr. William Losh, commenced soda works on the Tyne; this district being, in fact, the cradle of the soda manufacture in England.

The chief points of interest I was desirous of directing my attention to were—the difference in the arrangement and construction of "plant" in the two countries; the quality and cost of the raw materials employed in the manufacture; the technical results obtained in the different departments; and the organisation of the French workmen, and the wages paid. To some extent, all these necessarily vary in different parts of France, but the main features may be given.

There appears to be no published statistics in France relating to the consumption of materials in chemical works or the products therefrom. Perhaps one of the best tests as to the extent to which the soda manufacture is conducted in any locality is the consumption of salt, and I took some pains to ascertain this in France; and, as far as I could learn, the total consumption of salt for chemical purposes did not exceed 120,000 tons per annum. Part of this is employed simply in making sulphate of soda for glass works, and the rest in making soda. When we recollect that the salt used on the Tyne alone amounts to about 190,000 tons annually, the quantity used in France appears very small; this is partly accounted for from the fact of France being an importer of chemicals from England, and also that, owing to her bright and clear atmosphere and her sunny skies, the use of chemicals, in which soda occupies a part, are not so much required.

Chemical works are situated in different parts of France—at Rouen, Lille, Channy, Alais, Marseilles, and other places. Some of these works are very extensive, and one which I visited used as much as 23,000 tons of salt per annum. The supply of raw materials is obtained from various sources—pyrites are chiefly obtained in France itself and from Belgium, and the cost at some of the works is 47s. per ton, as compared to 26s. in England; coals are obtained in large quantities from Pas-de-Calais, also from Belgium, and certain classes of coals from the Tyne and Cardiff, and they cost about 22 to 28 francs per ton (the French coal is not at all bad for firing purposes, but contains a good deal of ash); salt costs about 28 francs per ton, the Belgium ground rock-salt, which is at present being imported there, being rather less; manganese of 70 per cent costs as much as £8 10s. per ton; but the supply of limestone is both abundant and cheap. It will be seen, therefore, from the above prices, that the raw materials in France are f

* A Paper read before the Newcastle Chemical Society, November 25, 1875.

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considerably dearer than in England. This partly arises rom the position of the works and from other causes, but still the fact remains the same. On the other hand, wages of workmen are all much lower than in this country, but at the same time the work turned out by each man is less. It may, however, be safely stated that the daily wages of workmen in France for this class of work are 20 to 30 per cent lower than with us. As far as I could myself judge from seeing them at work, and also from visiting their houses, which I had the opportunity of doing, the workmen were industrious, frugal, and orderly, drinking being little known, and they were more subject to discipline and the control of their foremen than with us. Broadly speaking, it may be stated that in France nearly all raw materials employed in chemical works are much dearer than in England; that labour is cheaper; that the quality of the products manufactured is generally far superior to importations from England, the better colour and purity being easily distinguishable.

A few technical details may not be out of place before this Society. The pyrites used sometimes vary in quality, but are generally non-cupreous, and contain from 46 to 48 per cent of sulphur; the charge in the burners is light, not exceeding 7 cwts. in twenty-four hours; and the burners appear to be carefully attended to, and leave an ore containing not more than 1½ to 2½ per cent of sulphur as loss. The yield of sulphuric acid, as might be expected, is very good, being about 135 per cent in the pyrites. Owing to the heat of the climate in summer, the chambers are generally entirely roofed in, and are kept very neat and clean. The men in this department, as in all other, work twelve-hour shifts, and are paid 3s. per day, as compared to 5s. in England.

In the sulphate of soda department, the furnaces are large and have three beds, but they only work about 2½ tons of salt in twenty-four hours, as compared to 10 tons in England. This small quantity is worked chiefly with the object of obtaining a complete condensation of [illegible] so[illegible] is consequently very fine. The hydrochloric acid gas is conveyed through long cooling pipes to an extensive series of Wolff's fire-clay bottles, which are manufactured very skilfully and at moderate prices in different parts of France. It may be stated that it generally requires about one hundred of these bottles to each furnace, and the gas which finally escapes to the flue is reduced by this careful method of working to a very small percentage of loss. As far as I could calculate on the spot, this system of condensation is considerably less costly, as far as erection is concerned, than the stone or brick towers adopted in England; and even after allowing for the furnace only turning out one-third of the quantity as compared to this country, the French condenser plant is little more than half of ours, and the results appear to be better. This is shown by the green fields and growing trees, in some places, near the works. The acid obtained is also very strong, standing from 30° to 32° Tw. The workmen are paid 3s. 4d. per day of twelve hours.

The balling process, again, is differently conducted to ours. The sulphate of soda, coal, and limestone are first finely ground, and a much heavier charge of materials than we use is put into the furnace at once, but the number of balls made is fewer. For instance, in some places 17 to 18 cwts. of charge constitutes a ball, in the place of 8 cwts. as with us. Six balls only are drawn out in a twelve hours' shift; and in other works the weight is still greater, being as much as 40 cwts. for a charge, and three balls in twelve hours. Owing to the slowness of working, and the moderate fire-heat applied, it is not found necessary to use much more than the chemical equivalents in the mixture. For instance, instead of using 50 per cent of mixing coal on the sulphate, the French only use 25 to 30 per cent. The balls produced are consequently nearly a cream colour instead of being a brown-black, as with us. They are so dense and hard, however, that they find it necessary to have them broken to small pieces before being sent to the vats. The wages in this department are 3s. 4d. per day as compared with 5s. 3d. here, but three men are required in the place of two in England. The vat-liquors are generally boiled down in open pans, from the waste heat of the ball furnace, the salt being fished out, and the remaining red liquors are used in making caustic soda.

In some works the black salt so obtained is re-dissolved in pure water, settled, and then evaporated and calcined in brick furnaces with a dished bottom, similar to those employed in England twenty-five years ago. The soda-ash obtained by this plan of working is very white and pure, and nearly resembles the English refined alkali.

This calcined ash is used in making the French soda crystals, the solution being crystallised in small metal dishes, about 15 to 18 inches diameter and 9 inches deep, producing a very good quality of soda. In a hot climate like that of France it would be found very difficult to crystallise the soda-liquors in large vessels, as in England, and the use of small vessels appears to overcome the difficulty, and the produce obtained is quite as large as in the colder climate of England. The dishes are placed in long rows, two deep and four in height, and appear to be easily worked, the cost of wages being not more than in England.

The soda is afterwards carefully dried on shelves in another department, and then packed in casks for the Paris market. Owing to the care and cleanliness throughout, and the chemical purity of the materials, the French soda brings 2 francs per cwt. more in the Paris market than soda imported from England.

I will now turn for a few moments to the bleaching-powder process. At the time of my visit the Weldon process had not yet come into operation, but several works were erecting plant for the purpose. I will, therefore, describe the old manufacture, which is so familiar to most of us in the room. [illegible] stills [illegible] to the Wolff's bottles already referred to. A charge of about 50 lbs. weight of ground manganese is used, and hydrochloric acid of 30° to 32° is added. In some works the vessel is heated from below by means of a flue, and in others it is heated by steam. An almost complete decomposition of the manganese takes place, which consequently produces a larger yield of bleach than in England, no manganese being practically wasted. The chlorine is conveyed part of the way to the chambers in glass pipes, so that, from the colour of the gas, it is not difficult to see when the manganese is worked off, and the still is ready for another charge. The bleach-chambers are made of stone flags, containing a series of shelves upon which the lime is spread, and the bleach is not brought up higher than 32°, which is the usual French standard. In one work which I visited as much as 6000 tons were made annually.

At some of the works it was pleasant to notice, in a social point of view, that large schools were established for the education of the children of the workmen: I visited a school where 600 children were being taught. News rooms, concert halls, and billiard rooms were also connected to these works, and on Sundays the workmen flock to these places of amusement in considerable numbers to enjoy themselves.

Chemical manufacturers in England have, for many years past, laid themselves out for the establishment of works with very large productive powers—quantity being the main thing in view. One reason given for this has been that, owing to our high-priced labour, it was absolutely necessary that a large weekly turn out should be accomplished. Apparatus in chemical works has also been constructed on a similarly gigantic scale: and in this competitive race I fear it must be acknowledged that superior colour, excellence of production, and general chemical purity have been to some extent forgotten. On the other hand, the French, with their dear materials, their small but many

times multiplied apparatus, the constant application of the chemical laboratory to every process, the cleanliness and care of their frugal and saving workmen, are producing chemical products which—although in nearly all cases dearer than in England—are certainly of superior quality, from which the English manufacturer may learn a lesson.

NOTES UPON THE ANALYSIS OF ANIMAL CHARCOAL.

The Estimation of Carbonate of Lime and Lime in Char.

By G. C. STEWART, F.C.S.,
Chemist at the Cappielow Sugar Refinery, near Greenock.

Fresenius,* and more recently Crookes,† recommend Schiebler's volumetric process in estimating the amount of carbon dioxide gas evolved from the carbonate of lime in animal charcoal.

With all due respect to the experienced chemists who are in the habit of using this process, it appears to me clearly that the most accurate results are obtained from the gravimetric method. Now I would here wish it to be distinctly understood that it is not my purpose to condemn Schiebler's beautiful method of estimating carbon dioxide in carbonates—far from it; the fact that all other writers upon the subject at issue coincide with me that the results obtained from Schiebler's process are "about" (I mean *only* approximately) correct is sufficient. As this sort of thing does not suit me when I have occasion to analyse char, I have, after using the process (Schiebler's), gone back to the antiquated method of determining carbon dioxide in carbonates *by the loss in weight*, and I find that I get results which are admitted to be generally correct.

For the gravimetric method of determining the amount of carbon dioxide evolved from the carbonate of lime in bone-char, all that is necessary is one of those "classical" carbonic acid apparatus the production of which now-a-days make our Continental neighbours notorious in the art of glass-blowing. I recommend that from 4 to 5 grms. of the charcoal should be weighed out into the receiver of such an apparatus, and the carbonate of lime decomposed with dilute hydrochloric acid in the ordinary way, the carbon dioxide evolved from the earthy carbonate being taken as a measure of the amount of carbonate of lime actually existing in the char as such. Forty-four parts of carbon dioxide are equivalent to 100 parts of carbonate of lime.

All samples of charcoal contain a very small proportion of ferrous sulphide (FeS), which, when acted upon by the dilute hydrochloric acid, liberates sulphuretted hydrogen; but the error arising from this source (if any at all) must be very trifling indeed.

During my experience in this class of work, I have had occasion to analyse a great number of samples of animal charcoal from widely different sources, all of which contained sulphides, and, as the result of my experience, I have never found more than about half per cent of the evolved gases to be sulphuretted hydrogen.

To prevent the evolution of this gas, it is best to add a few drops of mercuric chloride to the hydrochloric acid used in the decomposition, and, of course, the only gas evolved is carbon dioxide. The results are very satisfactory in the hands of an experienced manipulator.

Free lime is not an infrequent constituent in bone-char, particularly the "stock charcoal" of sugar refineries; the amount ranges from 0·1 to 0·5 per cent. How this free lime comes there is not the question; the fact that the charcoal contains it is sufficient.

It is best estimated, also gravimetrically, by carbonating about 5 grms. of the charcoal in a carbonic acid apparatus with solution of ammonium carbonate, and decomposing after carbonation with dilute hydrogen chloride as above.

On comparing the result obtained from this experiment with the previous one, a slight increase in carbonate of lime will no doubt be observable. This excess is calculated to (CaO) lime, and reported as such.

Chemical Laboratory,
Cappielow Sugar Refinery,
November 6, 1875.

(To be continued.)

* Fresenius's "Quantitative Chemical Analysis."
† Crookes's "Manufacture of Beet-Root Sugar."

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 266.)

His method of preparation, which is still in use, is as follows:—A known amount of concentrated hydrochloric acid is diluted in a beaker with 8 to 10 volumes of water, and exposed to a freezing mixture. A quantity of barium peroxide, somewhat less than sufficient to neutralise the acid, and as free as possible from other oxides (especially from manganic oxide, which would decrease the yield), is ground up to a fine pulp with water, and gradually added to the acid, in which it should dissolve without effervescence. Dilute sulphuric acid is then cautiously added, in order to throw down the dissolved baryta as sulphate and liberate hydrochloric acid, which then serves to react upon a further quantity of baric peroxide. After the liquid has been filtered off from the barium sulphate, a new dose of pulpy barium peroxide is added, and the above-described process is several times repeated. After the sixth or seventh addition the liquid contains a sufficient amount of the peroxide of hydrogen. If perfect freedom from acids is required, it is successively treated with sulphate of silver and hydrate of barium. The filtrate is concentrated over sulphuric acid in a vacuum.

Pelouze adds a paste of barium peroxide to a solution of hydrofluosilicic acid, and filters the solution of peroxide of hydrogen from the fluosilicate of barium.

Dupré† and Balard use a solution of carbonic acid in water for the same purpose, adding gradually very small quantities of finely pulverised peroxide of barium.

Recently J. Thomsen has proposed the following modification of Thénard's process‡:—Finely-ground peroxide of barium, or the commercial so-called hydrate, is dissolved by addition to dilute hydrochloric acid, till the latter is almost neutralised. To the filtered and cooled solution so much baryta-water is then added that foreign oxides and silica are thrown down, and a slight precipitate of barium peroxide is formed. The solution is then filtered and mixed with a sufficient quantity of concentrated baryta-water, whereby, as was shown by Brodie,‖ crystalline hydrated peroxide of barium is deposited. The precipitate is filtered and washed till it no longer shows the reaction of hydrochloric acid. The hydrate thus obtained can be preserved for a long time in closed vessels in the moist state. To obtain peroxide of hydrogen it is added, with stirring, to dilute sulphuric acid. The concentration of the latter may reach 1 part of acid in 5 parts of water. When the solution shows only a very faint acid reaction the sulphate of baryta is allowed to settle, and the liquid is filtered.

(To be continued.)

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."
† Dupré, *Comptes Rendus*, lv., 736 and 758.
‡ Thomsen, *Ber. Chem. Ges.*, 7, 74.
‖ *Pog. Ann.*, cxxi., 372.

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PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 2nd, 1875.

Professor ABEL, F.R.S., President, in the Chair.

AFTER the names of the visitors had been announced, and the minutes of the previous meeting read and confirmed, Messrs. A. N. Gow, G. Bischof, G. W. Davey, and H. Child were formally admitted Fellows of the Society. The names read for the first time were those of Messrs. W. H. Watson, E. H. Gaskell, T. S. Davis, S. E. Levy, W. L. Howie, M. Roberts, G. W. Wood, J. Hargreaves, H. Wilson Hake, E. Yewdall, and H. Glover. Messrs. W. Salvador Curphey, J. Hersham, Gerald Warbrick Rawlins, A. Boak, R. Lilburn Barnes, W. E. Halse, T. H. Dodd, R. Harvey, J. F. M. Harris Stone, E. H. Girling, T. McKean, A. Taylor, T. H. Bland, S. Wills, E. H. Cook, J. Campbell Oman, J. Clough Thresh, A. W. Postans, P. R. Ogle, F. C. Desvignes, F. M. Jennings, and S. A. Szczepanowski were then balotted for and duly elected.

The first paper, "*On the Decomposition of Alcohol and its Homologues by the Joint Action of Aluminium and its Halogen Compounds*," by J. H. GLADSTONE and A. TRIBE, was read by the former. When iodine dissolved in absolute alcohol was poured on finely-divided aluminium a powerful action takes place, and hydrogen was evolved in abundance. The pasty residue in the flask, when heated to 100° C., gave off alcohol and left a solid residue, which, at 275° C., became liquid, alcohol and an oily body containing iodine passing over. The fused residue in the flask, when heated to a still higher temperature, was decomposed with formation of alcohol, ethylen, and alumina; but under diminished pressure a different result was obtained—a greenish white solid sublimed, which, on analysis, was found to be aluminic ethylate, $Al_2(C_2H_5O)_6$. This is the second instance on record of an organo-metallic body containing oxygen which is capable of distillation, cacodylic oxide being the other. Similar results were obtained with aluminic iodide or aluminic bromide, and aluminium was employed instead of aluminium and free iodine, but the action was less energetic. Amylic alcohol acted in the same way as ordinary alcohol.

The PRESIDENT said they were much indebted to the authors for the account of this interesting research.

Mr. C. E. GROVES then read a "*Note on Incense Resin*," by Dr. J. STENHOUSE and himself. This resin, which is the produce of a tree indigenous to British Guiana, and is also known as "Gum Hyawa," or resin of Conima, contains, besides an essential oil, a crystalline and a non-crystalline resin. The essential oil, which is extracted in the usual way by distillation in a current of steam, has the empirical formula, C_6H_8, and appears to belong to the $C_{15}H_{24}$ group. *Conimene*, which is the name the authors have assigned to it, boils at 264° C., and possesses a pleasant aromatic odour. It is polymerised by the action of sulphuric acid. The crystalline resin forms minute colourless needles of the composition $C_{46}H_{76}O$. It melts at 175°, and is but moderately soluble in boiling spirit.

The PRESIDENT having thanked the authors,

Mr. J. SPILLER read a notice "*On the Occurrence of Native Calcium Chloride at Guy's Cliffe, Warwickshire.*" In the course of a tour through Warwickshire the author visited Guy's Cliffe, and on several parts of the face of the low sandstone cliff there he noticed a black slimy exudation, as if it had been bedaubed with tar, and some of this black slime was collected for examination. The results of the analysis, which was rendered somewhat difficult by the presence of dead leaves and stalks, and living algæ, were given, and show the presence of a very large percentage of calcium chloride. This material, as it is washed away by the rains, is constantly renewed, and would seem to point to the existence of salt-beds in the neighbourhood.

The CHAIRMAN, in thanking the author, remarked no doubt there were many other gentlemen present who, like himself, had visited Guy's Cliffe without noticing this interesting substance to which Mr. Spiller had directed their attention.

Dr. THUDICUM said it would be interesting to know to what geologic period the sandstone belonged, as a considerable bed of sandstone had to be penetrated at Stassfurt before the salt-bed was reached, and a substance very similar, he believed, to that examined by Mr. Spiller had led to their discovery.

In reply to a question by Mr. T. B. Groves, the AUTHOR said the apparently black colour of the specimen was due to the dark green of the algæ present, mixed with decomposing organic matter.

Mr. G. S. JOHNSON then communicated a note "*On Certain Sources of Error in the Ultimate Analysis of Organic Substances containing Nitrogen.*" The author, whilst making a combustion of an albumenoid substance with lead chromate and freshly reduced metallic copper, was anxious to ascertain if any nitrous acid had escaped reduction, and on testing the contents of the potash bulbs obtained abundant evidence of the presence of nitrous acid. On examining the original solution of potash, however, it was also found to be contaminated with potassium nitrite. This is likely to be a source of error in the carbon, as such potash absorbs oxygen, and increases in weight when a current of dry pure air is passed through it. Another source of error is the occlusion of hydrogen by metallic copper which has been reduced in a current of dry hydrogen, even if it be subsequently heated to 150° C., rendering the hydrogen determination too high.

Dr. WRIGHT said he could confirm Mr. Johnson's account of the occlusion of hydrogen by copper, for he had always observed, with nitrogenous substances burnt with lead chromate and metallic copper, that the hydrogen came about 0·5 per cent too high, whilst the excess in ordinary non-nitrogenous substances was only about 0·2.

Dr. VOELCKER said he would like to point out certain sources of error in the determination of nitrogen in highly nitrogenous bodies, especially albumenoids, if the combustion was not performed with sufficient precautions. In the first place it was necessary to have the substance very finely divided and intimately mixed with the soda-lime, otherwise the nitrogen would be too low. Again, hydrogen may not be present in sufficient quantity to cause all the nitrogen to be evolved as ammonia, but this source of error might be avoided by mixing sugar with the substance. A third cause of error was the employment of too high a temperature, as in the extreme heat of a Hofmann's gas-furnace, when the nitrogen was apt to be partly dissociated into its elements; the combustion should be performed at a dull red-heat. This loss was increased if too long a tube were used, or if the mixture was burnt too slowly. If nitrates were present along with albumenoids it was necessary, in order to obtain accurate results, to wash out and determine the nitrates and ammoniacal salts, and then burn the albumenoids in the usual way.

Dr. ARMSTRONG said he could confirm the observation about the occlusion of hydrogen by metallic copper, for in the combustion in a vacuum, after a good one had been obtained by the Sprengel pump, as soon as the copper was heated the vacuum diminished, showing that gas had been given off. He found it advantageous to substitute silver for copper, which answered admirably if strongly heated.

The CHAIRMAN, in thanking the author, said he was glad this paper had served to introduce such a valuable and interesting discussion.

A paper "*On Certain Bismuth Compounds*," by Mr. M. M. P. MUIR, was then read. When bismuth is heated in a current of chlorine the two unite, and a beautifully crystallised sublimate of the trichloride is obtained. It

melts at 225° to 230° C., and may be distilled unchanged in a current of dry carbonic anhydride. The tribromide was prepared in a similar way, but forms flat, brilliant, yellow crystals, which melt at 210° to 215°. The author has studied the action of water and of ammonia on the tribromide, and gives details of the results obtained, as also of the preparation of the so-called bismuthic acid by passing chlorine through bismuthous oxide, Bi_2O_3, suspended in a boiling solution of caustic potash. It still retains traces of chlorine, however, but this may be removed by boiling the chocolate-red product with strong nitric acid, which changes it to a brilliant scarlet. It then has the composition $HBiO_3$, but when heated to 120° C., it loses water, and leaves bismuthic oxide, Bi_2O_5. The attempts to obtain salts of bismuthic acid failed.

The last communication was "*On Bismuthiferous Tesseral Pyrites*," by Dr. W. Ramsay. It contains the results of the analysis of a specimen of this mineral from the museum of Glasgow University. The formula deduced is $(Ni,Cu,Fe)(AsBi)_3$.

The meeting then adjourned until Thursday, December 16, for which the following papers are announced :—"On Narcotine, Cotarnine, and Hydro-cotarnine (Part III.)," by C. R. A. Wright and G. H. Beckett; "Communications from the Laboratory of the London Institution," by H. E. Armstrong; "On the Sebates of the Alcoholic Series, and Note on Sebate of Cobalt," by E. Neison; and "On some Compounds of Ether with Anhydrous Metallic Chlorides," by P. P. Bedson.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, October 28th, 1875.

John Pattinson, President, in the Chair.

President's Address.

(Continued from p. 266.

The supply of water to towns has excited much attention of late, and many towns have had to suffer from an insufficient supply as well as from bad quality. In our own district, as you all know, we have from time to time been supplied with water so muddy as to be unfit for use even in baths. In the frequent examinations of this water it has been my duty to make, I have usually found it of good quality when separated by filtration from the matters it held in suspension. But surely in the water supply of a large town like ours, containing many thousands of inhabitants unable to take means to filter the water themselves, it is not too much to expect that this necessary of life should be supplied in such a condition of clearness as to be fairly suitable for drinking purposes. So long as the source of supply is to a great extent from surface drainage, from whatever district it is taken, we may expect that the water will occasionally be turbid owing to high winds or from the accession of flood water. Even the famed Loch Katrine water is from time to time reported by the official examiner as being turbid. Only deep-well waters, such as the Sunderland water, are free from this objection. The only effectual remedy for this turbidity is to have the water carefully and thoroughly filtered by passing it through beds of gravel and sand before it is allowed to enter the mains for distribution. This is an operation which can be readily and economically accomplished. All the surface water supply of London is treated in this way. The Newcastle and Gateshead Water Company are now preparing filters for this purpose, so that we may hope shortly to be supplied with water reasonably free from suspended matter at all times and fairly suitable for drinking. In order to have a very bright and pleasant water it will probably still be necessary to use house filters. These can now be had at a moderate price, and they do their work very effectively if they are not choked up by the very muddy water which it is now sometimes necessary to pass through them Those provided with a sponge to remove the most of the insoluble matter, and which can be readily taken out and cleaned, are perhaps the most useful. It is now well known that a good filter not only separates insoluble matters (to which at one time its action was thought to be limited), but it also oxidises and removes the organic matters in solution. The following analysis shows the effect of filtration on a sample of water in this respect—the figures represent grains per gallon :—

	Unfiltered. gr.	Filtered. gr.
Nitrogen existing as ammonia.. ..	0·001	0·001
Albumenoid nitrogen..	0·007	0·004
Nitrogen existing as nitrites and nitrates..	0·064	0·046
Oxygen required to oxidise organic matters (permanganate test) ..	0·074	0·014

The unfiltered water also contained a considerable amount of matters in suspension which was also removed by the filter.

The Sale of Food and Drugs Act has become law during the last session of Parliament. There is no doubt that, in many respects, this Act is a great improvement on the Adulteration Acts it supersedes. Provision is made to secure the punishment of the real offender when food or drugs have been tampered with, and to protect the retail dealer who may not have the opportunity of knowing whether or not his goods are pure; the inspectors appointed to take samples can now compel the sale to them of a reasonable quantity of the article suspected to be adulterated; if the accuracy of the chemist's analysis be disputed, the seller has the right to have the sample sent for analysis to the chemical officers of the Inland Revenue Department, as well as the right of appeal to a superior court; and many other improvements are introduced. One of the articles of food which is still most extensively adulterated is milk. Most of the convictions which have been obtained, both in our own district and elsewhere, have been for selling mixtures of milk and water. So long as paltry fines of about 10s. are imposed by the magistrates for this offence, we are still likely to have much milk adulteration practised. The dealers can well afford to pay an insignificant fine of this kind out of the plunder they obtain from the sale of water at the price of milk in the ninety-nine cases out of a hundred in which they escape detection.

A subject of very great importance to this district is now being investigated by a Royal Commission. I allude to the subject of the spontaneous combustion of coal in coal-laden vessels. There has lately been a considerable increase in the number of cases of fire arising from this cause. From statistics collected by Mr. R. Cooper Rundell, and given by him in a Report to the Underwriters' Association of Liverpool, it appears that, taking the number of vessels carrying upwards of 500 tons of coal which have sailed from the United Kingdom for ports south of the Equator during the first nine months of the years 1873 and 1874, the number of casualties from spontaneous combustion was 23, or about 2 per cent of the total number of vessels in 1873, and 50, or about 4 per cent in 1874. The statistics further show that the fires are not confined to one kind of coal, but have occurred in most, if not all, kinds exported from all parts of the United Kingdom. The theory which attributes spontaneous combustion to the presence of pyrites in the coal is consistent with the recent increased number of cases, if we consider that owing to the extraordinary demand for coals and a high price of labour, the coals were more likely to be shipped without being so carefully freed from "brasses" or iron pyrites in later years than they were formerly. On the other hand, Richters has pointed out that, in the kinds of coal he experimented with, the coal which contains most pyrites is not that which is most liable to spontaneous combustion; and

his researches have shown that atmospheric air is rapidly absorbed by coal, and that the oxygen thus absorbed probably afterwards combines with the organic constituents forming carbonic acid and developing heat. In all probability the heat which gives rise to spontaneous combustion is developed both by the oxidation of iron pyrites as well as by the oxidation of the carbonaceous constituents of the coal; and that in the holds of vessels, where large cargoes of coal lie unventilated, or but imperfectly ventilated, this heat accumulates. and may ultimately be high enough to set fire to the cargo. The whole subject requires further investigation, and the Royal Commission now formed will, no doubt, not only elicit valuable information as to the causes of these sad disasters, but also suggest means of preventing them.

In our chemical works a few cases have recently been known where bleaching-powder has spontaneously heated so as to set fire to the casks in which it was packed. So far as I am aware, these cases have only occurred when the bleaching-powder has been rapidly made and hurriedly packed. If this be so, the heating can be readily avoided. But the phenomena of the heat of chemical action are constantly being met with in our chemical operations, and are in many cases but imperfectly understood. A knowledge of the laws regulating the development and absorption of heat, both of chemical action and of ordinary combustion, is of the utmost value to the technologist, and is almost indispensable for the intelligent and economical working of many of the new processes recently introduced into our chemical works. How valuable an intimate knowledge of these laws may become has been well shown in the admirable researches on the "Chemistry of the Blast Furnace," by our first president, Mr. Bell. Many a useless and expensive experiment would be avoided, and many hitherto inexplicable phenomena would be understood, if our technologists would make themselves thoroughly acquainted with these laws so far as they are known.

The inaugural address of a society like ours appears to me to afford a suitable opportunity for placing on record a notice of the various new processes and improvements which, from time to time, are introduced into the chemical arts and manufactures; and I now purpose, very briefly, to describe some of the most notable of these inventions which have been recently brought into practical use, both here and elsewhere.

Although many and great improvements have from time to time been made in almost every stage of the manufacture of soda, which forms the staple of the chemical trade of this district, yet the process in its main features still remains the same as when it left the hands of the famous Le Blanc; and, so far as can be seen at present, the great bulk of the carbonate and hydrate of soda required by the civilised world is still likely in the future to be produced by furnacing sulphate of soda with chalk, or limestone and coal. The only rival plan which has hitherto met with any measure of success is the so-called "ammonia process," in which common salt is decomposed by bicarbonate of ammonia. In England this process is now carried on somewhat extensively, I believe, by Messrs. Brunner and Mond, of Northwich. The obligations imposed upon these gentlemen by the patentees of the process prohibit their revealing any particulars as to the exact mode of procedure. It is certain, however, that a very pure carbonate of soda is produced, and that this is now meeting with a ready sale for glass making, for which purpose, owing to its freedom from sulphates and other impurities, it is well adapted. Messrs. Brunner and Mond appear to have succeeded in overcoming the objection which some glass makers have had to their produce on the score of its being more bulky than the refined alkali made by the ordinary process. By the kind permission of Messrs. Reid and Hall, Messrs. Brunner and Mond's agents in this district, I am enabled to give the following complete analysis of this ammonia-made carbonate of soda. The sample was taken by me from a parcel of several casks, and the analysis was made in my laboratory:—

	Per cent.
Carbonate of soda	98·72
Sulphate of soda	0·20
Chloride of sodium	0·54
Carbonate of lime	0·13
Carbonate of magnesia	0·04
Peroxide of iron	0·01
Alumina	0·01
Silica	0·09
Moisture	0·32
	100·06
Soda by English alkalimetrical test	58·50

It will be seen that this is a very pure article. Other samples have been examined by me which contained as much as 58·7 per cent of soda by the English commercial test.

It is said that the plant required in this process is of a very delicate nature, and very liable to get out of order, and that the alkali is produced at a very high cost as compared with that produced by the ordinary process; so that, excepting for fine glass making, and for other purposes where extreme purity is of greater importance than price, it is not likely to meet with very extensive application. Moreover, it is said that 5 per cent of the ammonia used in the process is lost for every ton of alkali made. If this be so, were all the ammonia produced in the distillation of coal for gas making in the United Kingdom diverted from its important uses in agriculture and other purposes, and used for restoring the waste in this process, it would only, I estimate, be sufficient for about three-fourths of the soda-ash at present made by the Le Blanc process in the United Kingdom. But long before this point could be reached ammonia would rise to a prohibitory price. Unless, therefore, some other source of ammonia be discovered this process can only have a comparatively limited application.

(To be continued.)

CORRESPONDENCE.

THE RIVERS COMMISSION.

To the Editor of the Chemical News.

Sir,—I am obliged to your correspondent for pointing out an error in a foot-note to one of the Appendices of the Sixth Report of the Rivers Commission.

The error in question is entirely an editorial one, made by myself, and has no bearing whatever upon the accuracy of the analytical results, which were obtained by Mr. W. Thorp, late chief analyst in the laboratory of the Rivers Commission. It occurred in the following way:—The results of the experiments quoted by your correspondent were sent to me from the Rivers Commission Laboratory, by Mr. Thorp, in the following form: "1 litre of pure water containing 0·001 grm. nitrogen as sulphate of quinine (C. = 0·008571 grm.) gave 0·000996 grm. N. and 0·00912 grm. C." In writing the article on potable water for Dr. Hofmann's "Report on the Development of the Chemical Arts during the last Ten Years," I wished to give the weights of sulphate of quinine which contained the specified quantities of nitrogen and carbon; and, in calculating these weights I inadvertently used the formula $C_{20}H_{24}N_2O_2.SO_4H_2+7H_2O$, instead of—

$$(C_{20}H_{24}N_2O_2)_2SO_4H_2+7H_2O.$$

From this article the error was copied into the foot-note already alluded to.

The bottle containing the standard solution of sulphate of quinine employed in the experiments is now in my

possession in this laboratory, but at the time the article was written for Dr. Hofmann it was in the Rivers Commission Laboratory in Westminster, and I could not conveniently refer to its label, from which I now copy—"Sulphate of quinine, ½ litre = 0·7786 grm. = 0·05 grm. N. 10 c.c. = 0·001 grm. N."

The following is therefore the corrected statement of the calculated and experimental results referred to by your correspondent :—

To 100,000 parts of a sample of water rendered as nearly chemically pure as possible, 1·5572 parts of sulphate of quinine were added. The following data compare the quantities of organic carbon and organic nitrogen thus actually added to the water, with those afterwards found in two analyses :—

	Present.	Found. I.	Found. II.
Organic carbon in 100,000 parts of water..	0·857 part.	0·912	0·904
Organic nitrogen in do. do...	0·100 ,,	0·0996	0·098

To 100,000 parts of a similar sample of water 0·7786 part of sulphate of quinine was added, and the following results obtained on analysis :—

	Present.	Found. I.	Found. II.	Found. III.
Organic carbon in 100,000 parts of water	0·429 part.	0·435	0·442	0·440
Organic nitrogen in do. do.	0·050 ,,	0·047	0·048	0·048

To 100,000 parts of a third similar sample of pure water 0·07786 part of sulphate of quinine was added. On analysis this water yielded the following numbers :—

	Present.	Found. I.	Found. II.	Found. III.
Organic carbon in 100,000 parts of water	0·043 part.	0·047	0·050	0·055
Organic nitrogen in do. do.	0·005 ,,	0·006	0·005	0·006

—I am, &c.,

E. Frankland.

Royal College of Chemistry, South Kensington Museum, December 6, 1875.

THE RIVERS COMMISSION.

To the Editor of the Chemical News.

Sir,—The letter on the Report of the above Commission which appeared in your issue of the 3rd inst. demands a reply from me.

Dr. Frankland has, I believe, written to you explaining the error which led to the insertion in the Report of the statement that "1·957 parts of sulphate of quinine" were employed, so that I need say nothing on that point, but proceed to describe the exact mode in which the experiments were made.

From his calculation that 1·957 parts of sulphate of quinine contain 0·1469 part of nitrogen, it appears that your correspondent assumes that the anhydrous salt was employed; but this was not the case, the ordinary hydrated sulphate being used. A solution was made containing in ½ a litre 0·7786 grm. of the salt, and 10 c.c. of this, when made up to a litre with pure water, produced a solution containing 1·5572 parts of sulphate of quinine, or 0·1 part of nitrogen in 100,000 parts. The formula which I employed was that given in Miller's "Elements of Chemistry," viz., $(C_{20}H_{24}N_2O_2)_2H_2SO_4+7H_2O$, but two others have been proposed. In Watts's "Dictionary of Chemistry" $(C_{20}H_{24}N_2O_2)_2H_2SO_4+7\frac{1}{2}H_2O$ is given, and in Schorlemmer's "Chemistry of the Carbon Compounds" $(C_{20}H_{24}N_2O_2)_2H_2SO_4+8H_2O$; but if either of these be taken as correct, instead of that given by Miller, the facts are not materially altered. If the salt used contained $7\frac{1}{2}H_2O$ the quantity of nitrogen in 1·5572 parts would be 0·099 part instead of 0·1 part, and if it contained $8H_2O$ it would be 0·098 part, and the numbers actually obtained in the analyses correspond still more closely with these than with the first number 0·1.

In reporting to Dr. Frankland the results of these experiments I did not state the quantity of sulphate of quinine used, but merely said that a certain quantity of nitrogen, in the form of sulphate of quinine, had been employed.

It will thus be seen that the accidental error in the Report which has given occasion to this correspondence in no way affects the accuracy of the experiments.—I am, &c.,

William Thorp, jun.,
Late Chief Assistant in the Laboratory of the Rivers Commission.

39, Sandringham Road, E., December 6, 1875.

TESTING SODA-ASH.

To the Editor of the Chemical News.

Sir,—In your impression of last week (Chem. News vol. xxxii., p. 267), in the Report of Mr. Pattison's Address to the Newcastle-on-Tyne Chemical Society, he refers to the difference in the estimate in testing soda-ash, &c., existing between the chemists on the Tyne and those in Liverpool: surely, then, this is a matter that should be cleared up in this advanced age of commercial chemistry. I fear I may intrude too far on your space, but I will narrate an occurrence of the old times of our "barilla" and "kelp" alkali (before the days of "Soude-factice") bearing upon the present point. A large parcel of Spanish barilla was sold, the value to be decided by two analytical chemists of that day—one on the part of the merchant, the other for the buyer, a soap-maker. Their reports differed somewhat widely. Upon this it was agreed to refer the case to the great Faraday (I must so term him): his report as to its value again differed from the other two. Upon being told this, *he* said he could go no further into the matter, but if those two gentlemen would come to him he would show them how they were wrong. This was told me by my father, and he and those referred to have all since passed away.

In conclusion, I must declare that *we*—as *consumers* of the soda-ash—ought only to be called upon to pay for the actual soda therein (the only value to us), and not for apparent value, by absorption of the "test" acid, by the lower oxides of sulphur than the sulphates. I could say a great deal more on this subject, but for the reason I have above stated. I need scarcely say I am *not* an analytical chemist, but—I am, &c.,

A Soap-Maker.

Southwark, December 7, 1875.

MANUFACTURE OF SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

Sir,—Your correspondent "Carbon" wishes to know how the loss arises from the use of acid containing arsenic in the manufacture of white ammonium sulphate. If "Carbon" had ever such acid in hand to make this salt with, he would have found to his cost the cause of the loss. The sulphate acquires such a disagreeable dirty yellow colour from the presence of arsenic trisulphide that buyers will not look at it except a large slice is cut from the price. "Grey" or even "black" sulphate would be taken in preference. Inexperienced persons might imagine that iron was the colouring agent, but of course ferrous sulphate imparts a green tinge to the salt, turning rusty by age. The remedy is easy, and no chemist could be taken in with such acid a second time. In my own experience I have only once met with an acid so rich in arsenic as to produce the effect described, but possibly others may have been oftener tried, as I always insisted where any voice was left to me upon the use of "sulphur" vitriol, as long as the prejudice exists for buying by colour

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instead of ammoniacal richness and freedom from sulphocyanide.—I am, &c.,

R. FRAZER SMITH.

Greenock, November 29, 1875.

CRYSTALLOGRAPHY.

To the Editor of the Chemical News.

SIR,—My note in your Journal (CHEM. NEWS, vol. xxxii., p. 225) was intended to elicit what substances have been observed to crystallise (perfectly or nearly so) in the following forms, viz.:—The oblique sphenoid, the doubly-oblique sphenoid, the doubly-oblique rectangular prism, the doubly-oblique rectangular pyramid, the doubly-oblique rhombic prism, and the doubly-oblique rhombic pyramid.

Allow me to apologise for writing the word *sphenoid*, in my former note, so badly that your compositor should read it *spheroid*. The "morphology of crystals" is sufficiently perplexing without the invention of any new terms, and certainly I have no such desire. The question I have asked is interesting, and possibly important.—I am, &c.,

T. A. READWIN.

November 30, 1875.

"THE BIRTH OF CHEMISTRY."

To the Editor of the Chemical News.

SIR,—A recent number of the CHEMICAL NEWS (vol. xxxii., p. 144) contains a letter from Mr. Rodwell, author of "The Birth of Chemistry," referring to my "Outlines of a Bibliography of the History of Chemistry," which you did me the honour of republishing. Mr. Rodwell, in his letter, makes use of the following language with reference to our knowledge of the chemistry of the Egyptians:—"When we remember that the science originated in Egypt, and that the very name is derived from an Egyptian source, we can but hope that—in the progress of Egyptian discovery—as valuable information in regard to the history of chemistry as has already been found in regard to astronomy may be brought to light."

This hope has been in some measure realised by the appearance of a facsimile of an Egyptian medical treatise written in the 16th century, B.C., which, when fully deciphered, will undoubtedly prove of immense value to the student of the history of chemistry. The title of this work (translated) is as follows:—"*Papyrus Ebers*, the Hermetic Book of Medicines of the Ancient Egyptians, in Hieratic Writing. Published, with Synopsis of Contents and Introduction, by George Ebers. . . . Leipzig: William Engelmann. 1875. 2 vols., folio."

This is not the place to enter upon a description of this remarkable document; we can only call attention to its probable age and authorship. Palæographic studies of the manuscript, the occurrence of the names of kings, and a calendar written on the back of the first page, have enabled Ebers to assign the writing to the middle of the 16th century, or, more precisely, B.C. 1552; in short, prior to the exodus of the Israelites.

The authorship of this ancient treatise is not revealed, but it bears internal evidence of being one of the six Hermetic books on Medicine named by Clement of Alexandria, and is ascribed, on the first page, to the god *Thuti* (or Thoth), the famous Hermes Trismegistus of the Greeks. At the time of Jamblichus, A.D. 363, the priests of Egypt showed forty-two books attributed to Hermes (Thuti). Of these, thirty-six contained the history of all human knowledge; the last six treated of anatomy, of disease, of affections of the eye, instruments of surgery, and of medicines. The "Papyrus Ebers" is indisputably one of these ancient Hermetic works.

Ebers gives a Synopsis of the contents of the entire work, and a literal translation of the first two pages of the roll (of which there are 110 in all), reserving a complete translation with commentary for a future publication. Since the "Papyrus" is marvellously well preserved, and does not speak vaguely of incomprehensible and fantastic ideas, but furnishes indubitable insight into different phases of Egyptian manners and customs, the archæologist and historian, as well as the student of science, will await with impatience the fuller translation promised.—I am, &c.,

H. CARRINGTON BOLTON.

School of Mines, Columbia College, New York, November 26, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 20, November 15, 1875.

Specific Gravity of Pure Platinum and Iridium and their Alloys.—MM. H. Sainte-Claire Deville and H. Debray.—Pure platinum was found to have the specific gravity 21·504. Iridium gave 22·421. An alloy of 90 platinum with 10 iridium 21·615, showing a contraction of 0·0012. Another alloy of 85 platinum and 15 iridium was found 21·618, the contraction being 0·0003. An alloy of 66·67 platinum and 33·3 iridium gave 21·874, the contraction amounting to 0·0034. A brittle alloy of 5 platinum with 95 iridium = 22·384, and the contraction was 0·0006. The specific gravities of platinum and iridium are higher than have been hitherto found, and the specific gravities of the alloys increase in a very regular proportion, which affords a presumption in favour of their purity.

Researches on the Constitution of Dissolved Salts and Acids.—M. Berthelot.—Reserved for insertion in full.

Memoir on the Measure of the Affinities between the Liquids of Organised Bodies by means of Electromotive Forces.—M. Becquerel.—Not adapted for abstraction.

Fifteenth Note on the Electro-Conductivity of Sparingly Conductive Bodies.—M. Th. du Moncel.

Certain Compounds of Titanium.—MM. C. Friedel and J. Guerin.—In a certain number of its compounds titanium is unquestionably analogous with silicium. The researches of M. Marignac on the fluo-salts of silicium, titanium, tin, and zirconium, have brought certain of these analogies to light. Other analogies result from the comparison of the chlorides, bromides, and iodides of silicium and titanium, and between the ethereal compounds of titanium and the ethyl-titanic trichlorhydrine of Friedel and Crafts, and the titanic ether of Demarcay. Along with these resemblances we find also differences. We know of no silicates resembling the known titanates. Hypersthen, the mineral which most nearly approaches in its composition to the numerous and varied titanatas of iron, offers no analogy to them in form and aspect. Of the three forms of crystalline titanic acid, not one approaches that of silica. The authors, therefore, deemed it important to undertake a re-examination of certain compounds of titanium, and have studied the dichloride and the dititanic hexa-chloride.

Solution of Platinum in Sulphuric Acid during the Industrial Process of Concentration.—M. Scheurer-Kestner.—The author concludes from his experiments that the loss of weight in platinum stills is not due to a simple mechanical action of the boiling acid. When the acid is free from nitrous compounds it dissolves about 1 grm. of platinum for 1000 kilos. of acid concentrated to 94-100. If the concentration is carried to 98-100, 6 to 7

grms. are dissolved, and 9 if the acid is prepared at 99·5 per cent. If nitrous compounds are present the amount of metal dissolved is in much larger proportion. Platinum alloyed with iridium is much less attacked, an advantage, however, which is, to a great extent, compensated by the brittleness of the alloy.

New Alkaloid, Ergotinin, found in the Ergot of Rye.—M. Ch. Tanret.—This compound is a fixed solid, exists only in very small amount, and is very readily affected by the air, which renders its extraction difficult. Like all the alkaloids it has a decided alkaline reaction, and saturates acids. It yields precipitates with the double iodides of mercury and potassium, with the iodurretted iodide of potassium, phospho-molybdic acid, tannin, chloride of gold, chloride of platinum, and bromine water. Its most striking reaction is the colour which it gives with moderately concentrated sulphuric acid—a yellowish red, which becomes an intense violet-blue. If it has been exposed to the air for some minutes it loses its distinctness, and finally is no longer produced. Its saline solutions, on exposure to the air, quickly become rose coloured, and then red. If the extractive liquor is distilled with a concentrated solution of soda or potassa, mere traces of the alkaloid are obtained, but, instead, a large amount of methylamin—doubtless a product of its decomposition. In another experiment, where the liquid had been submitted to prolonged evaporation in the air, nothing but ammonia was obtained, all the alkaloid having disappeared. The great instability of this alkaloid may explain the rapid alteration of the powder of ergotised rye.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 11, November 11, 1875.

This issue contains no chemical or physical matter except what has been already noticed elsewhere.

No. 12, November 18, 1875.

This issue contains a notice of an establishment at New York for preserving fish, &c., by cold.

M. Schrœder, of Baltimore, proposes to convey the American mails to Hamburg, Paris, and Lisbon in six days. He hopes to effect this by means of an invention for steering balloons, and which is to enable him to cross the Atlantic in fifty hours.

M. Toselli has made great improvements in diving-bells and in machines for grappling and raising objects from the bottom of the sea. He makes use of a powerful electric lamp. When this lamp is in action multitudes of fishes of all sizes collect around it. M. Toselli proposes, as a new kind of fishery, to kill them by the explosion of a torpedo. (We presume the torpedo will have the discretion not to damage the electric lamp.)

Two projects are put forward for dealing with the sewage of Paris. The one proposes to extend the conduits of Gennevilliers to the forest of St. Germain, and increase the surface of land to be irrigated. The other is to construct, at the expense of 70 to 80 million francs, a special canal conveying the sewage to the sea. The latter scheme is strongly supported by the Municipal Council.

M. Reimann's Färber Zeitung,
No. 43, 1875.

This issue contains receipts for a green and a grey on half-woollen goods; for dyeing and finishing blue shirtings; and for printing a puce, red, and rose (garancin style).

No. 44, 1875.

In a notice on the incrustations in steam-boilers it is shown that they may be prevented, either by the introduction of metallic zinc, or by adding to the water milk of ime sufficient to convert any acid carbonate of lime into he mono-carbonate.

There are various dyeing receipts of no especial interest.

MISCELLANEOUS.

Obituary.—With regret we announce the death, on the 30th of November, of M. Emile Kopp, the Professor of Chemistry at the Polytechnic School of Zurich. This distinguished chemist, whose valuable researches we have so often had occasion to record, was in the fifty-ninth year of his age. The cause of his death was an attack of apoplexy.

Royal Institution of Great Britain.—At the General Monthly Meeting, held on Monday, December 6, 1875, the following arrangements of the Lectures before Easter, 1876, were announced:—

Prof. Tyndall, D.C.L., LL.D., F.R.S.—Six Lectures, adapted to a juvenile auditory, on "Experimental Electricity." On Dec. 28 (Tuesday), 30, 1875; Jan. 1, 4, 6, and 8, 1876.

Prof. Alfred H. Garrod.—Twelve Lectures on the "Classification of Vertebrated Animals." On Tuesdays, Jan. 18 to April 4.

Prof. Gladstone, F.R.S.—Eight Lectures on the "Chemistry of the Non-Metallic Elements." On Thursdays, Jan. 20 to March 9.

Wm. Spottiswoode, Esq., LL.D., Treas. R.S., Sec. R.I.—Four Lectures on "Polarised Light." On Thursdays, March 16 to April 6.

R. P. Pullan, Esq., M.R.I.B.A.—Three Lectures on his "Excavations in Asia Minor." On Saturdays, Jan. 22, 29, and Feb. 5.

W. T. Thiselton Dyer, M.A., B.Sc., F.L.S., Assistant-Director, Royal Gardens, Kew.—Four Lectures on the "Vegetable Kingdom; the Boundaries and Connections of its Larger Groups." On Saturdays, February 12 to March 4.

Prof. G. Croom Robertson, M.A.—Three Lectures on the "Human Senses." On Saturdays, March 11, 18, and 25.

Edward Dannreuther, Esq.—Two Lectures on "Wagner and his Trilogy," with pianoforte illustrations. On Saturdays, April 1 and 8.

The Friday Evening Meetings will begin on January 21, 1876, at 8 o'clock; the Discourse by Prof. Tyndall, at 9 p.m. The succeeding Discourses will probably be given by Prof. Huxley, Mr. W. Preece, Mr. Wm. Crookes, Dr. C. W. Siemens, Lord Lindsay, Earl Stanhope, Prof. W. H. Flower, Sir H. S. Maine, Prof. Odling, Mr. E. B. Tylor, and Prof. James Dewar. To these meetings Members and their friends only are admitted.

University of London.—The following is a list of the candidates who have passed the recent B.Sc. Examination for Honours:—

Mathematics and Natural Philosophy (B.A. and B.Sc. conjointly).—First Class: R. C. Rowe, B.A. (Scholarship), Trinity College, Cambridge; H. F. Morley, B.A., University College. Second Class: W. H. Bennett, B.A., Lanc. Indep. and Owens Coll.

Chemistry (B.Sc. only).—First Class: J. M. H. Munro, Royal Coll. of Science, Dublin; A. J. Smith, Owens College; S. P. Thompson, B.A., Royal School of Mines. Third Class: F. A. Cooper, Owens and University Colleges; J. E. Harris, B.A., private study; C. M. Thompson, University College.

NOTES AND QUERIES.

Coal-Tar.—A Subscriber will be glad to be informed of the best and most recent authority on the chemistry and distillation of coal-tars, showing the character, boiling-points, and specific gravity of the various products.

Magnesia Bricks.—Can you or any of your readers inform me where and how magnesia bricks are made, or where I can get information on the subject?—P. D.

TO CORRESPONDENTS.

Inquirer.—(1) Angell and Hehner's "Butter; its Analysis and Adulterations" is published by Daldy, Isbister, and Co., 56, Ludgate Hill, E.C. (2) Suffolk's "Microscopical Manipulation," price 3s. 6d., published at our office.

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THE CHEMICAL NEWS.

Vol. XXXII. No. 838.

ON THE ESTIMATION OF ARSENIC AS MAGNESIUM AMMONIUM ARSENIATE AND AS MAGNESIUM PYRO-ARSENIATE.

By R. W. EMERSON MACIVOR, F.C.S., Mem. Phys. Soc. Lond.

The present communication contains an account of a series of experiments on the methods of Levol and Rose for estimating arsenic. I was induced to take the matter up from the circumstance of my having been compelled to reject Levol's process, on account of its yielding low results, while engaged in making some accurate determinations of arsenic. I was subsequently led to study Rose's method.

Levol's Method: Determination as Magnesium Ammonium Arseniate.—This process, as commonly recommended in analytical handbooks, may be briefly described as follows:—The arsenic, after separation from other metals, is obtained in solution as arsenic acid, and then converted into ammonium arseniate by the addition of excess of ammonia. A solution of magnesium sulphate, containing sufficient ammonium chloride to prevent the precipitation of magnesium hydrate, is next added, and the whole allowed to stand for about twelve hours, so as to render the precipitation of the arsenic complete. The $MgNH_4AsO_4+6H_2O$ is collected on a tared filter, washed with dilute ammonia, dried in an air-chamber at a temperature of 105° to 110° C. until weight becomes constant, when the dried precipitate is assumed to have a composition represented by the formula $2MgNH_4AsO_4+H_2O$. Regarding the reliability of this method, chemists express diverse opinions. Some, as Fresenius, Field, Wittstein, and Puller, consider it reliable, while others again, as Rammelsberg and Parnell, condemn it as yielding only approximate results. For my own part I share the opinion of the last named chemists. As already mentioned, I obtained low results with the process, and was consequently led to doubt the correctness of the formula assigned to the arseniate as expressing its composition after drying at 110°. A number of experiments on the effect of different temperatures on the salt were accordingly made.

The arseniate employed was prepared as follows:—A solution of pure arsenic acid was rendered strongly alkaline with ammonia, and carefully-prepared "magnesia mixture" added. The precipitate was thoroughly washed with cold water, partially dried between the folds of bibulous paper, and finally thoroughly desiccated over oil of vitriol. A portion of the dried salt was then submitted to analysis, with the following result:—

Mg	8·25
As	25·82

The theoretical percentages of arsenic and magnesium contained in $MgNH_4(AsO_4)+6H_2O$ are:—

Mg	8·31
As	25·95

It is evident, therefore, that the salt has, as already found by Rose, this composition after drying over ordinary vitriol.

Having proved the composition of my salt, the following experiments were proceeded with:—1·5015 grm. was maintained at 105° to 110° until weight became constant. The total loss amounted to 0·5832 grm. = 38·84 per cent.

1·3050 dried at 105° to 107° lost 0·4943 grm. = 37·88 per cent.

1·4550 grm. by drying at 100° lost 0·5439 grm. = 37·38 per cent.

1·0820 lost 0·3682 grm. = 34·05 per cent. after about twenty hours' heating at 95°.

Assuming $2MgNH_4AsO_4+6H_2O$ to lose 11 molecules of water by drying at 105° to 110°, the total theoretical loss would be 34·25 per cent.—a number much below that actually found. If we, however, assume, with Field, that the salt loses the whole of its six molecules of water, the percentage loss rises to 37·37. This number is considerably lower than the loss found to take place at 105° to 110°, but agrees very well with that taking place at 100°. Field's view, however, is untenable, since I found ammonia to be expelled from the arseniate at a temperature somewhat below 100°.

In order to determine the quantity of ammonia given off at 105° to 110° the following experiment was made:—A weighed quantity of arseniate was introduced into a tube, so arranged that it could be kept at any required temperature, and connected at one extremity with a U-shaped tube containing dilute hydrochloric acid, and which in its turn was attached to an aspirator, by means of which a slow current of air was maintained passing through the tubes. The tube containing the arseniate was heated to 105° to 110° for about two hours, when the contents of the U tube were transferred to a porcelain basin, and the ammonium choride determined with platinum tetrachloride. The platinum-ammonium choride was, by ignition, converted into metallic platinum, which was then weighed. 2·0514 grm. $MgNH_4AsO_4+6H_2O$ gave 1·0464 grms. Pt = 0·0903 NH_3 = 4·4 per cent.

From the above results I draw the conclusion that Levol's method—as commonly recommended in text-books—can only yield approximate results.

Before concluding this portion of my paper I may mention that the expulsion of ammonia from the double arseniate was first noticed by E. W. Parnell, and more recently by Rammelsberg. It is now almost two years since I first made the observation in the laboratory of Professor G. Bischoff and, consequently, long prior to the publication of Rammelsberg's paper, and I was not aware of the fact having been already established until my attention was drawn to Parnell's paper by Dr. W. Ramsay.

Rose's Method: Determination as Magnesium Pyro-arseniate.—As in the case of Levol's process, diversity of opinion exists regarding the validity of this method. It is upheld by Levol, Rammelsberg, Thorpe, Puller, and Wittstein, and condemned by Fresenius and Parnell. My experiments fully confirm the excellence of the process. I do not, however, find it necessary to observe many of the precautions recommended by Puller, Wittstein, and others. My mode of working the process is as follows:—

The double arseniate is dried at 120°, introduced into a porcelain crucible and heated in an air-bath first at about 140°, and afterwards at 180°, then over a Bunsen burner, the flame of which is slowly raised, and finally finishing over the blowpipe.

Scientific Chemical Laboratory,
Andersonian University, Glasgow.

ON THE PYROLOGICAL COMBINATION OF ZINC WITH HYDRIC METAPHOSPHATE.

By W. A. ROSS.

The following experiment was made with the view of attempting a solution of the question as to the origin of hydrogen evolved:—

(1.) The procedure is based upon the observation that a fragment of pure *zinc* contained in a *bead of fused phosphoric acid*, which latter is *gently* heated before a long (or

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peroxidising) pyrocone* of the blowpipe, is (apparently) decomposed with considerable detonation, accompanied by brilliant phosphorescent scintillation, and the evolution of copious bubbles of *gas*, having the smell of what chemists call phosphine, or hydric phosphide, or phosphuretted *hydrogen*.

	M.grms.
(2.) On December 1, 1875, a clean, new, platinum wire, ringed at one end with (δ) forceps†, was weighed in a Freiburg assay balance; weight ..	=60·1
(3.) This wire, having a bead of *phosphoric acid* fused on it, weighed	137·5
(4.) Therefore the phosphoric acid bead weighed	77·4
(5.) The bead and wire, after the former had been submitted to the *strongest* OP‡ for *sixty seconds*, weighed..	126·0
(6.) Loss in weight from the volatilisation of *pure* phosphoric acid	11·5
(7.) The phosphoric acid bead, therefore, now weighed..	65·9
(8.) A fragment of *pure zinc* was now attached to the warmed side of the bead (5), and the wire, bead, and zinc weighed	134·3
(9.) Therefore the fragment of zinc weighed ..	8·3
(10.) Weight of (8), after all bubbles of phosphuretted *hydrogen* had been eliminated by a gentle P.P., *directed solely on the bead, not on the zinc*‖..	128·0
(11.) The clear bead without bubbles, therefore, now weighed, alone	67·9
(12.) And the *loss* of (8), caused by the operation described in (10),..	6·3

Phosphoric acid fused before the blowpipe is, I believe, called by chemists "Hydric metaphosphate, ($2HPO_3$), which formula (apparently) does not suffice to thus produce phosphuretted hydrogen—

$$(H_3P)Zn + 2HPO_3 = (?).$$

Its atomic composition, however, is—

$$2H = 2 : 2P = 62 : O_6 = 96;$$

total weight = 160.

The atomic weight of zinc is 65·2, and, to determine the weight of the amount of phosphuretted hydrogen evolved by acting on hydric metaphosphate with 8·3 m.grms. of *pure zinc*, we have the ratio—

	At.wt. Zn.	M.grms. Zn.	H_3P.
As	65·2	: 8·3 ::	34·0 : x
	$34 \times 8{\cdot}3$		8·3
	65·2		272·0
			10·2

65·2)282·2(about 4 m.grms. H_3P evolved.
260·0

22·2
18·6

But the decomposition of the *whole bead*, of 65·9 m.grms., of hydric metaphosphate could only have produced about 7 m.grms. of H_3P; whereas the residual bead, including loss by volatilisation, *still weighed* 67·9 (11), *minus*, of course, the weight of the "zinc phosphate," *after* 6·3 m.grms. of gas had been evolved. I would therefore submit that the *hydrogen* in this case appears to have been evolved by the *zinc*, and *not* by the *hydric metaphosphate*.

* Symbol P.P., *vide* "Pyrology," page 58.

† *Vide* "Pyrology," page 70, fig. 38.

‡ For oxyhydrogen pyrocone: the *hottest* "flame."

‖ That no loss is occasioned by an imaginary volatilisation of zinc is proved by heating a bead of phosphoric acid containing a fragment of that metal on *aluminium plate*, even before a strong O.P., when, although an explosion takes place, and a beautiful yellow metallic colour is produced, there is *no zinc sublimate*, but a slight loss of *phosphoric acid* in the shape of minute balls projected over the aluminium.

ON NOXIOUS AND OFFENSIVE TRADES AND MANUFACTURES,*

WITH ESPECIAL REFERENCE TO THE BEST PRACTICABLE MEANS OF ABATING THE SEVERAL NUISANCES THEREFROM.

By H. LETHEBY, M.B., M.A., &c.;
Professor of Chemistry in the College of the London Hospital; late Medical Officer of Health and Public Analyst for the City of London; and President of the Society of Medical Officers of Health.

(Continued from p. 274).

AKIN to these are the processes for making *size and glue*. All sorts of gelatinous materials, as fresh English fleshings (cuttings of hides) from tanneries, kip fleshings from abroad, calves' pates, and the cuttings of skins called "hide pieces," dried sinews, sloughs (bones inside horns), with other such offal and garbage, as well as fresh bones, are the raw materials from which size and glue are made. The fresh fleshings, as well as the clippings of others which contain fresh lime, are steeped for several hours in water acidulated with sulphuric acid. Old fleshings, in which the lime is killed by becoming carbonate, are merely washed with water; and these with the other glue-making materials are put into large open boilers, "called glue-pans," with water, and are boiled for two or three hours by a naked fire, when glue is made, or by means of a steam coil, when size is the product, until they are dissolved. They are frequently stirred during this operation, in order that the fat may rise for collection. The liquid is then run off through a rough strainer into a tank, and allowed to settle for about half an hour, when it is either put into tubs and sent away as size, or it is allowed to set in wooden troughs, from which it is taken and cut up into blocks about a foot square, which are subsequently further divided by means of a wire into slabs and dried. The degree of concentration in making size is much less than that for glue, the point in the latter case being determined by the appearance of the cooked liquor upon a lump of alum. The residue in the glue pans is a mass of fibrous matter, called "skutch," which often contains enough fat to pay for another operation. The skutch is put into a boiler with enough sulphuric acid to dissolve the fibre (about 75 lbs. to a ton of skutch), and it is heated by high pressure steam blown into it. Under this treatment the fibre dissolves and so lets loose the fat, which rises to the surface. All these operations are offensive, and require to be managed with great care to prevent them from being a nuisance. The fleshings and other materials, for example, are frequently allowed to remain in heaps in hot weather until they putrefy, and the vapours from the glue pans and the skutch pans are exceedingly nauseous. It is proper, therefore, that the raw material should be used as quickly as possible or be kept in covered tanks, and the vapours from the covered pans should be conveyed through condensers or coolers, and thence to the furnace fires.

Manure Making.—Apart from the making of superphosphate of lime, which I shall hereafter describe, the manufacture of animal manure is frequently a frightful annoyance, from the circumstance that it is generally in the hands of small capitalists, who have very little regard for the health and comfort of the community. The raw materials are of the most heterogeneous character; as fleshings, breakings, and other refuse from tanners, fellmongers, soap-makers, fat-melters, bone-boilers, glue-makers, &c., together with all sorts of waste from furriers, wool-spinners, hair-dressers, &c.; putrid fish, putrid flesh, and the offal of markets and slaughter-houses; all of which are indiscriminately used as the basis of animal manures; and these are treated in vats or boilers with sulphuric acid and steam—there being rarely much pro-

* A Paper read before the Society of Medical Officers of Health. Communicated by the Author.

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vision for the destruction or neutralisation of the offensive vapours. Occasionally the operations are conducted in closed iron cylinders set vertically; so that the charge may be dropped into them at the top and let out at the bottom. When full they are made tight and submitted to the action of high pressure steam (from 30 to 50 lbs.), which is blown into them for ten or twelve hours. In this manner the materials are perfectly disintegrated, and after standing for a few hours to cool the liquid portion, consisting of water and fat, are first run out through a tap at the bottom, and then the solid parts are removed. Apparatus of this kind can be worked without annoyance to the neighbourhood; but if the manufacturer prefers to mix his materials in his own way, it should be done in a close chamber or cylinder with revolving arms, and with a contrivance for carrying the offensive gases to the furnace fire. Other operations, as *fish drying* and *smoking*, and the *preparation of albumen* from *blood* and *eggs*, also deserve notice as requiring attention and cleanliness to guard against nuisances.

Animal Charcoal Burning.—This until lately was a great annoyance to the inhabitants of the neighbourhood in which sugar bakers reside. Formerly the bones were burnt in iron retorts set in a furnace without much precaution against the escape of the offensive empyreumatic vapours; and the red-hot charcoal was cooled and quenched in iron boxes by means of water, whereby much sulphuretted hydrogen was evolved. The processes, however, at present in practice are planned with every consideration for the public comfort. The retorts are so constructed that the vapours from the ignited bones are carefully conducted to the furnace-fire and are burnt; and the red-hot bone black is received into specially designed coolers that do not permit of the access of atmospheric air, which would be destructive of the carbon of the bones. When the animal charcoal has become exhausted of its decolourising power, it is again burnt and revivified in revolving retorts, or in well-designed vertical cylinders, which do not permit of the escape of any offensive matter into the surrounding atmosphere, but discharge it into the furnace-fire.

The roasting of coffee, chicory, and cocoa, if not properly managed, is offensive. The operation is performed in a revolving cylinder or cage set over a coke or charcoal-fire enclosed in a tight chamber, which is ventilated to the chimney shaft. In the case of coffee and cocoa the roasting operation is often performed in wire cylinders; whereas that of chicory, on account of the large quantity of powder produced, is always of sheet-iron. The cylinders are about 4 feet long and 20 inches in diameter. They receive about a hundredweight at a charge, and they are run into the roasting chamber upon a square axle, which supports them over a clear fire about a foot above it. They are then set in gear, and turned by machinery at the rate of about fifty revolutions a minute. There are breaks in the interior of the cylinder to distribute the coffee or chicory during the roasting so as to equalise the action. The operation lasts about thirty or thirty-five minutes for coffee or chicory, and half the time for cocoa; and the empyreumatic vapours go into the fire and up the chimney shaft. When the operation is finished, in the case of coffee and cocoa, the roasted berries are cooled by a blast of air, and this blows about a quantity of the outer covering of the coffee berry (called flights), which are occasionally annoying to the neighbourhood. The loss of weight during these operations is from 14 to 16 per cent for coffee, from 9 to 11 per cent for cocoa, and about 25 per cent for chicory. *Brown malt* and *roasted corn* are likewise roasted in much the same manner, and require that the empyreumatic vapours should be carried into the fire and be burnt.

There is another vegetable matter which in burning has lately caused offence to the neighbourhood in which the operations are conducted. This is the resinous matter obtained by the evaporation of the alkaline liquor obtained in the treatment of *Esparto grass and straw in paper-making*. The liquor is first evaporated in large close evaporating pans, which receive the full force of the fire above and below, and thus the vapours are carried forward into the chimney shaft. When the residuum is sufficiently consolidated it is roasted in a furnace for the pupose of burning off the organic matter and recovering the alkali. This operation has been forced upon the paper-makers in consequence of the difficulty of disposing of the spent liquors. The residuum of the evaporation would no doubt serve as a means of preventing scale or fur in steam boilers.

Within the last ten years a new branch of industry has sprung up in this country on account of the permission to use sugar as well as malt in the production of beer. The sugar is called *saccharine*, or *glucose*, or *grape sugar*, and it is generally made from the cheapest and most accessible kinds of starch. Rice starch is that which is commonly used in this country at the present time. The rice is crushed between rollers and macerated in a vat with a little alkali for about twelve hours, during which time it is constantly stirred by revolving arms moved by machinery. In this manner the gluten of the rice is dissolved out of it, and the starch is set free. After standing quiet for about six hours the starch settles, and leaves a supernatant solution of gluten, which is generally thrown away. The starch is then transferred to another vat and treated with water acidulated with sulphuric acid About 150 lbs. of acid (sp. gr. 1·850) and 1500 gallons o water are sufficient for a ton of starch. The mixture is stirred like the last, and it emits a smell of rancid butter and grains (butyric and lactic acids). It is then run into a vertical cylinder called a "digester," where it is submitted to the action of steam, at 20-lbs. pressure, blown into it for about half an hour. This converts the starch into glucose, and the solution is allowed to flow into a vat, where it is neutralised with powdered chalk and kept stirred for about two hours, during which time the same offensive smell of butyric and lactic acids is evolved, and to a much greater extent. The clear liquor is next filtered through horsehair bags to separate sulphate of lime, after which it is evaporated *in vacuo* to the consistence of a very thin syrup, which is filtered through animal charcoal in the usual way. It is then further evaporated *in vacuo* until it looks like honey, and in this state it is poured into moulds and allowed to set. The yield of starch from the rice is as much as 80 per cent, and the yield of sugar is about 5 per cent above the weight of the starch. The saccharine or grape sugar, when well made, contains from 80 to 82 per cent of glucose, with only a trace of gum and mineral matter; and it is generally used by the brewer mixed with two parts of malt. The offensive effluvia from these operations are easily prevented by covering the vessels and ventilating them into the fire or chimney shaft.

(To be continued.)

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 276.)

The three last-named methods may be considered as adapted for industrial purposes. As the peroxide of hydrogen does not solidify at −30° its solutions may be concentrated by cooling them below 0°, and allowing the water to freeze out. For this purpose Houzeau makes use of the apparatus of Carre.† A great difficulty in the

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."
† Houzeau, *Monit. Scient.*, 1868, 175.

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way of the commercial preparation of peroxide of hydrogen lies in its instability. This substance requires to be preserved in well-closed vessels and in acidulated solution, and even thus it requires great caution. Wood-charcoal and certain oxides and metals, especially silver, gold, and platinum in a state of fine division, decompose it by mere contact.

That it is a powerful oxidising agent, and that it even in the cold converts arsenious into arsenic acid, sulphide of lead into sulphate, and the lower oxides of manganese, iron, cobalt, barium, strontium, and calcium into the highest oxides of these metals, and that it at once completely oxidises arsenic and other elements, is not remarkable. But the more interesting and surprising are the observations of Thenard, extended and explained by Brodie in 1850, and shortly afterwards of Schönbein, according to which the peroxide of hydrogen acts not merely as an oxidiser, but as a powerful reducing agent; that it converts iodine into hydriodic acid,

$$I + H_2O_2 = 2HI + O_2,$$

that it separates metallic silver from silver oxide,

$$Ag_2O + H_2O_2 = Ag_2 + H_2O + O_2,$$

and reduces peroxide of manganese to manganous oxide,

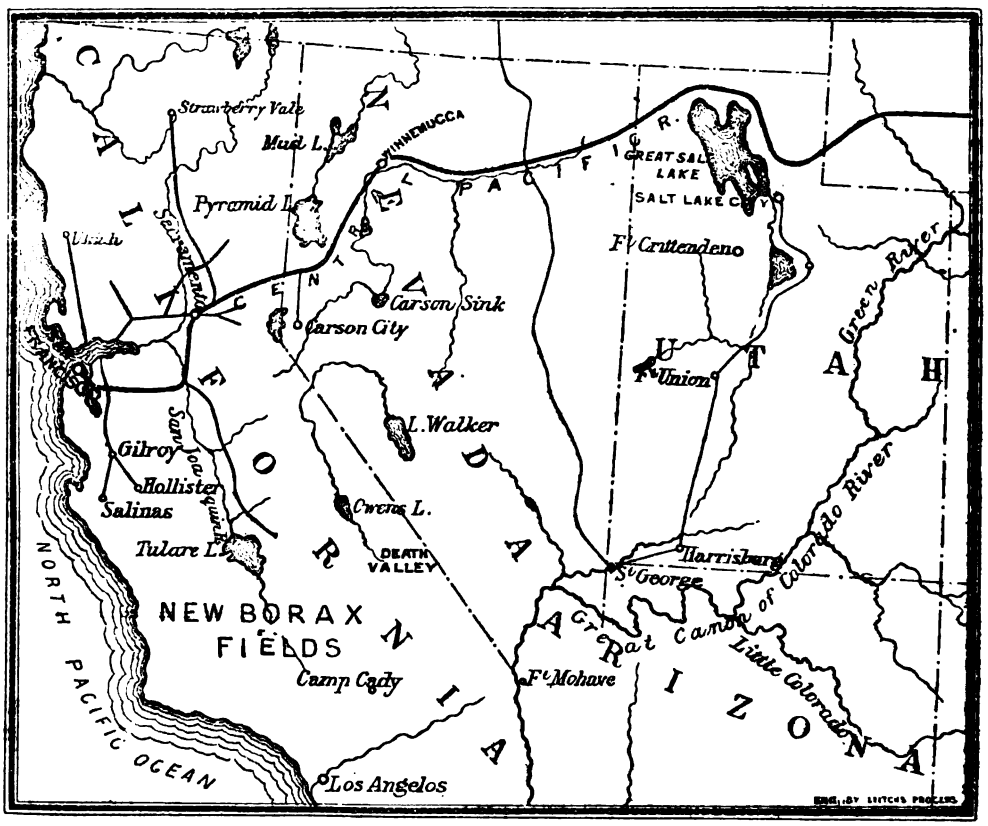
$$MnO_2 + H_2O_2 = MnO + H_2O + O_2.$$

In these reactions two atoms of oxygen coalesce to one molecule, which explains this strange phenomenon. At times peroxide of hydrogen acts almost simultaneously as an oxidiser and a reducer. Thus it converts chromic acid, CrO_3, transitorily into perchromic acid, which is very soon resolved into chromic oxide and free oxygen. If we, therefore, add to peroxide of hydrogen a few drops of a solution of chromate of potash and a little hydrochloric acid, and shake up with ether, the latter is coloured a deep blue by perchromic acid, but soon (especially if no ether is present) oxygen escapes and green solution of chloride of chromium remains. Similarly both actions appear simultaneously when solutions of ferrous sulphate and indigo are mixed with peroxide of hydrogen. The ferrous oxide is transitorily peroxidised and then again reduced, whilst the oxygen is transferred to the indigo and decolourises it.

By these effects of oxidation and reduction, both of which it displays in the highest degree, the industrial sphere of the peroxide of hydrogen is marked out. These effects, although mutually antagonistic, answer the same purpose for a certain practical operation, *i.e.*, bleaching sulphurous acid and zinc-powder, powerful reducers, as well as chlorine and ozone, powerful oxidisers, are all used as bleaching agents. How much the rather can this function be assigned to peroxide of hydrogen?

BORAX.

The trade in borax is likely to undergo considerable modifications in consequence of Mr. Arthur Robottom, of Birmingham, having found deposits of crude borate of soda at the bed of a dry lake in the Slate Range Mountains.



The position of the district may be seen from the map. The following description appears in the *California Alta*:—

"Beyond the Sierra Nevada, in the enclosed basin of North America, about 140 miles in a north-eastward direction from Bakersfield, there is the bed of a dry lake

* For the use of this woodcut we are indebted to the Editor of *British Mercantile Gazette*.

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filled over an area of 15 miles long by 6 wide with saline crystals to a depth of about 6 or 8 feet. The appearance of the surrounding country clearly indicates that water once stood 60 feet deep here over a large area, the ancient beach being distinctly traceable. The most remarkable fact about this saline product is that in its middle there is a tract 5 miles long and 2 wide of common salt, while on the outside there is a deposit of borate of soda 3 feet thick, and under this a lower stratum composed of sulphate of soda and tincal mixed together from 1 to 3 feet thick. These minerals are all in crystals, the sulphate of soda and tincal forming a solid mass, almost like stone in its hardness. The borate of soda is of a dirty hue, but the salt, which lies above the level of the entire deposit, in some places to a depth of 7 feet, is white as snow. The report of natural deposit thus situated will appear very improbable to scientific men, for there is nothing to account for the separation of the salt from the borates, or for the accumulation of salt above the level of other crystalline deposits. We have Mr. Robottom for authority, and the country is open for those who wish to examine for themselves. The place can easily be found. It is known as the Borax Fields in the Slate Range, and will be examined carefully by many competent men, since the tincal —a crude borate of soda—is a valuable mineral, and can be separated at little expense from the sulphate of soda. Mr. Robottom brought samples of the minerals along, and has shipped some of the tincal to England believing it can be obtained at less price than from Thibet, and of equally good quality. It is the most valuble borate mineral yet found on our coast, preferable for shipment to any of the borates obtained in Nevada, whereby the deposits are mainly borates of lime and soda. The Californian tincal can probably be used without refining for glazing fine pottery; and if so, it may drive the Thibetan tincal out of the market. Only time can determine which of California, Nevada, Thibet, Tuscany, Peru, and Chili—the principal producers of borax—can undersell the other. Tincal has not yet been found in Nevada, but it probably exists in several of the dry lake beds in the south-eastern part of this state. The deposits of borate of lime and borate of soda are numerous."

In May of the present year the men working at the lake informed Mr. Robottom that no rain had fallen since he was there in 1874. He says the men do not work much at the under surface, for they find the crude borate of soda that lies on the surface is easily crystallised, and on exposure of the crystals to the sun after they are taken out of the vat a white powder is obtained which is preferred by some of the potters to the refined borax of the English market. The following is an analysis of a sample of this Slate Range borax :—

Crystallised bi-borate of soda	99·75
Chloride of sodium	0·25
	100·00

For cleaning purposes it is far more economical and possesses great advantages over common soda and washing powders. On the occasion of his last visit to the district Mr. Robottom found a dead horse which had been left in a very thick deposit of the crude borate of soda. It had been there for more than four months, yet no offensive smell proceeded from it, although the thermometer stood at from 106° to 115° in the shade. The hair appeared to be quite firm on the skin.

The cost of transporting the borate of soda is being considerably reduced, so that prices will probably be much lower than at present.

Saccharification of Amylaceous Matters.—M. L. Bondonneau.—In all saccharification there are formed three products soluble in water, incable of reducing alkaline solutions of copper, and capable of entire transformation into glucose by hydration—properties characteristic of the dextrins.—*Comptes Rendus.*

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

December 11th, 1875.

Professor Gladstone, F.R.S., President, in the Chair.

The following candidates were elected Members of the Society :—C. Higgins and S. O. Thompson, B.A., B.Sc.

In the absence of Prof. G. C. Foster, Mr. Lodge exhibited and described a simple form of chronoscope for measuring short intervals of time, which Prof. Foster has recently devised. In experiments commenced about eight years ago, the apparatus consisted essentially of three parts—(1) An arrangement for releasing the bullet or other body whose fall was to be timed, when the apparatus is employed for such determinations; (2) an arrangement for directing a gauged stream of water into a vessel during the time occupied by the fall of the body; and (3) a platform to receive the falling body. The stream of water was directed into the vessel by means of a bent funnel brought under the constantly flowing stream by an electro-magnet. But this apparatus had two serious defects, one of which was caused by the difficulty of accurately gauging the stream, and the other by the inertia, and consequent sluggishness, of movement of the funnel. The arrangements, however, for dropping and receiving the bullet, being satisfactory, were finally adopted. The former is simply a clip, one side of which is a spring, and this forms the armature of a small electro-magnet. On completing the circuit the spring is drawn aside and the bullet released, momentarily breaking a current which passes through it, as subsequently described. The bullet, at the end of its fall, strikes a small mahogany table, so arranged that the blow slightly depresses it, and permanently breaks the same current, which in the interval has been closed by a subsidiary wire. The author abandoned the method of indicating the commencement and end of the fall by an independent electro-magnet, and substituting the trace made on blackened paper by a vibrating tuning-fork for the stream of water, he registered them by perforations made by induction-coil sparks in the blackened paper, a method suggested by the description of Beetz's chronoscope. The apparatus is difficult to describe without the aid of diagrams, but the following will perhaps sufficiently indicate the general arrangement:—The two terminals of the secondary coil are connected, the one with the tuning-fork, and the other with the metallic drum on which the blackened paper is carried. The other connections are as follows :—The current passes from one pole of battery to spring of releasing apparatus (which is also connected with one terminal of a separate condenser), thence through the bullet to the fixed portion of the clip and by a wire to the lower table, which is also in electrical connection with the face of the electro-magnet which releases the bullet, in order that the current may be completed immediately the falling body is released. From this table the current passes through an adjusting screw to one terminal of the primary wire of the induction coil which is connected with the other condenser terminal. The other pole of the battery is connected with the primary. The spark in each case is caused by the breaking of the current, which takes place when the bullet is released, and when it strikes the table, the perforations in the black paper of course being made in the trace produced by the tuning-fork. It is hardly necessary to mention that the releasing electro-magnet is worked by one or two independent cells. The author considers that with a fork making sixty-four complete vibrations in a second the error, in determining an interval of not more than two or three seconds, should not exceed 1-500th of a second, and that, with a more rapidly vibrating fork, probably much greater

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accuracy might be obtained. Mr. Lodge made four experiments before the Society, with falls of 2 feet and 1 foot, from which the value of gravity was found to be 32·21.

Prof. Guthrie inquired whether the instrument was sensitive to the influence of temperature on the time of vibration of the tuning-fork.

Mr. Ladd suggested that the pressure of the marker on the end of ihe tuning-fork might hinder its vibration, and referred to difficulties which Captain Noble had met with in the working of his chronograph.

Mr. Lodge stated that experiments had only been made in a laboratory having a fairly equable temperature, and that therefore the effect of considerable changes of temperature had not been ascertained. He considered that the slight resistance referred to by Mr. Ladd would rather tend to diminish the amplitude of the vibrations than to change their number per second.

Prof. McLeod then described and exhibited an arrangement for ensuring that the charge given to a Leyden jar shall not exceed any fixed limit. Through a cork in the upper end of a bell-glass passes a brass rod, insulated through its entire length by means of a glass tube through which it passes freely. To the upper end is attached a brass knob, and the lower end is pointed and provided with a screw-thread, so that it can be set at any distance within, or through a hollow brass ball, perforated below, and rigidly fixed to the glass tube. Within the bell-glass is a loose cage of perforated sheet zinc, and a vessel containing strong sulphuric acid. The whole stands on a metallic plate to secure a good earth connection. The action is as follows:—If the rod be screwed down so that the point projects through the hollow ball, the upper knob and lower metallic plate being connected with the two poles of a Holtz machine, only short sparks can be obtained, because a large amount of electricity escapes at the point, but if the rod be raised so that the point barely enters the hollow ball at the top no escape takes place from it, and the machine will give its full length of spark. By varying the position between these two extreme limits, any required length of spark, or amount of charge for interposed Leyden jars can be obtained.

Mr. C. F. Varley thought the method useful for roughly approximating to the required tension. He mentioned that the length of a spark between two balls or points is no accurate measure of tension, and referred to the experiments of Faraday and Sir W. Thomson.

Prof. McLeod explained that the instrument was in no way intended as a measure of electricity, but only to ensure that the charge obtained should not be excessive.

BRITISH PHARMACEUTICAL CONFERENCE.

Meetings of the Executive Committee, chiefly to entertain applications for grants of money in aid of chemical and pharmaceutical research, have been held on the first Wednesdays in November and December, in the rooms of the Pharmaceutical Society of Great Britain (by the kind permission of the Council of that Society), at 17, Bloomsbury Square, London. Present—Professors Redwood and Attfield, Messrs. Frazer, Groves, Hill, Schacht, and Williams.

After the confirmation of the minutes of the previous meeting, which included a resolution raising the salary of the editor of the Conference "Year Book" from £100 to £150, the following applications for grants were read, several being sent in response to requests or suggestions from the Committee :—

1. From Mr. A. W. Gerrard, £10 to cover cost of extraction of pilocarpine from jaborandi, with a view to its further chemical and pharmaceutical investigation.

2. From Dr. C. R. A. Wright, £20 to defray expenses in connection with the extended researches on the aconitines. Respecting this application Messrs. Hopkin and Williams had stated that they would gladly furnish Dr. Wright with concentrated extracts of the raw material for the mere cost.

3. From Mr. M. M. Pattison Muir, £5, with which to purchase the required quantity of essential oil of sage for a research.

4. From Mr. C. T. Kingzett, £10 to pay a portion of the cost of materials necessary for continued researches on the oxidation of essential oils.

5. From Mr. E. L. Cleaver, £10, with which to purchase opium for a thorough examination of the methods of ascertaining the proportion of morphia in the drug, and a report on a trustworthy mode of assaying opium.

6. From Mr. R. H. Davies, £5 to defray part of the cost of an investigation or the definite proximate principles of ivy berries.

7. From Dr. H. E. Armstrong, £10 for the purchase of strychnine with which to conduct a research on the oxidation products and bromo-derivatives of that alkaloid.

8. From Dr. W. A. Tilden, £5 to be expended in carrying on further investigations of the aloins.

Total number of applications, 8; total amount of money grants, £75.

On the motion of the President, it was resolved unanimously to grant to the gentlemen named the sums mentioned, to thank them for undertaking the several researches, and to request them to communicate results to the next general meeting of the Conference at Glasgow, on Tuesday and Wednesday, the 5th and 6th September, 1876.

The Honorary Secretary reported that since the meetings of the Committee in August he had received nearly 560 subscriptions of 7s. 6d. each from that number of members, all of which sums had been duly acknowledged and placed to the credit of the respective members. The number of members up to December was about 2800.

The Treasurer was ordered to invest in consols £200 of the balance in his hands, pending the consideration of the best mode of dealing with surplus income.

The Secretaries announced that the "Year Book" for 1875 was in type, that it would extend to six hundred and fifty pages, that it would be published on or about the 11th of December, and that a copy would be sent post-free to every member who had paid his annual subscription (7s. 6d., by P.O.O. payable at the High Holborn office to Professor John Attfield, Hon. Gen. Sec., 17, Bloomsbury Square, London, W.C.).

A letter was read from a member suggesting that the Conference should nominate, in connection with the Cambridge University Extension Scheme, a travelling Professor of Pharmacy, who should lecture in the provinces at different centres, and that the Conference should contribute towards his remuneration £150 per annum. After thoroughly discussing the proposal, the Committee were unanimous in the opinion that at present it would be unwise to include the great subject of education among the objects of the Conference. The Conference had been for the thirteen years of its life recognised as a body devoting its whole strength and resources to the prosecution of original research in connection with pharmacy, by issuing lists of subjects for investigation, publishing a "Year Book" of researches made at home and abroad, and granting money in aid of research; and, secondarily, by holding annual gatherings of members for friendly intercourse, as well as for the reading and discussion of the original papers. Support could not be awarded to any particular scheme of education without full consideration of the whole subject, and the latter could not be entertained with the probability of the Conference taking any important action in the matter without enlarging the organisation of the Conference and extending its work to areas already occupied by other societies. The Committee concluded that they were only anticipating the wishes of the members in declining to entertain the consideration of any plan of direct pharmaceutical education.

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MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 2nd, 1875.

R. Angus Smith, Ph.D., F.R.S., &c., Vice-President, in the Chair.

Peter Spence, F.C.S., &c., exhibited a piece of 2 to 3 inch lead pipe in which the metal had been entirely transformed into galena, the crystallisation being visible through the whole of the specimen.

The shape of the lead pipe was unaltered, showing that the lead had not been exposed to a melting heat; no increase of bulk was visible, but the pipe was so brittle as to shiver with a blow. The circumstances in which this change was effected, as nearly as can be made out, were as follows:—

The pipe had been used for the conveyance of gas ammoniacal water, and was sunk under ground. It was in the vicinity of a furnace which heated the ground where it lay. It had been disused for some years, but never taken up. When the ground where it lay had to be excavated for a new erection it was found that there had been a considerable leak of gas water, as the ground for some space was impregnated with ammoniacal salts. About 25 per cent of the ammonia in gas water being sulphide, and the ground being warm, a constant atmosphere of sulphide of ammonium would surround the pipe, and this seems to have been the cause of the conversion of the lead into sulphide, as only that part of the pipe which was in the vicinity of the leak was found to be transformed.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, October 28th, 1875.

John Pattinson, President, in the Chair.

President's Address.

(Continued from p. 279.)

Amongst the improvements which have recently been made in what may be described as the auxiliary processes of the Le Blanc method of soda-making, Mr. Hargreaves's invention stands out as one of the most radical and important. It has not yet been set to work in our district, but the Jarrow Chemical Company, I understand, are nearly ready to commence the plant they have been erecting. Mr. Hargreaves informs me that about 400 tons of sulphate of soda per week are now produced by the direct action of sulphurous acid on common salt in the Lancashire district and in Ireland. In addition to this, the plant being erected and preparing to start is equal to a further production of about 550 tons of sulphate of soda per week. I understand that one of the practical difficulties of this process consists in obtaining the salt in a suitable mechanical condition so that gases may penetrate every portion in the cylinders. The temperature also requires very careful regulation. The heat must be high enough, on the one hand, to enable the chemical changes to take place, whilst on the other it must not be so high as to melt the contents of the cylinders. The uniform rate at which the hydrochloric acid is evolved enables the condensation of this gas to be easily effected. Mr. Hargreaves says that 99·9 per cent of the total acid evolved is condensed,

Lawes's Chemical Manure Company have experimented with Dr. Sprengel's patented improvements in the manufacture of sulphuric acid, and, it is said, with marked success. Dr. Sprengel's process consists in injecting into the chambers a great portion of the necessary water in the form of spray instead of steam. The spray is produced by means of a jet of steam issuing at a pressure of about 30 lbs. into the centre of a flow of water. These jets are introduced in the sides of the chambers at intervals of about 40 feet. The apparatus is inexpensive, and it is said the saving of fuel, acid, nitre, and labour, during the three months the process had been at work, amounted to about 5s. per ton of acid of 1·600 specific gravity. If these statements are borne out, and there are no counterbalancing disadvantages in the process, we shall, doubtless, soon hear of its being in use on the Tyne. Dr. Sprengel tells me that he is already introducing it into six different works in other districts.

An apparatus for concentrating sulphuric acid has been devised by Messrs. Faure and Kessler, of the Clermont-Ferrand Chemical Works, in France, which appears to have advantages over the old processes in point of cheapness of first cost and economy of working. The concentration is made in flat, shallow, dish-shaped vessels, made either of platinum or porcelain. The dishes are covered by a leaden dome or chamber, which is contrived to condense the acid fumes evolved and to conduct them into the leaden chamber. The cost of evaporation is said to be reduced one-half. It appears this apparatus has been adopted in about twenty chemical works in various parts of the world. It has not yet been used on the Tyne.

A marked improvement has, I think, been made in the apparatus for decomposing salt, by Messrs. Jones and Walsh, of the Middlesbro' Chemical Works. Instead of the ordinary decomposing pan and finishing furnace, Messrs. Jones and Walsh substitute a flat-bottomed circular pan, about 14 feet in diameter, having a rim about 6 inches deep, in which the process of decomposition by sulphuric acid is begun and finished. The pan is furnished with a mechanical stirrer, which consists of a vertical axle resting in a footstep in the centre of the pan, having horizontal arms carrying scrapers and rakes. The stirring arrangement is made to rotate by suitable driving gear. The pan rests upon solid brickwork, and it and the mechanical stirrer are enclosed by arched brickwork. The necessary heat is derived from a coke fire, and passes over the surface of the batch, the products of combustion passing on with the evolved hydrochloric acid to the condenser. No heat at all is applied to the bottom of the pan. The furnace is charged with 40 cwt. batches of common salt and the necessary amount of sulphuric acid, and one of such batches is finished every six hours. Larger batches could be worked in the same-sized pan, if more powerful driving gear than has been used hitherto in the experimental furnace were applied. The wrought-iron work of the mechanical stirrer is not at all, or but very slightly, acted on by the acid, and the only parts it has been found necessary to renew during the three months the furnace has been at work are the scrapers, which appear to be worn by mechanical and not chemical action. The sulphate of soda formed is very uniform in quality, and is in a fine powdery condition, quite free from lumps. One of the advantages of this process is that the composition of the batch is entirely under control. Shortly before it is finished a sample is taken and tested for chlorides and free acid. If either is in excess, this is corrected at once by introducing a little more salt or sulphuric acid, as the case may be, and the batch made of the required composition before it is drawn from the furnace. There are no "fluxings" in this process, the bed of the furnace being kept quite clean by the action of the scrapers. I have made an analysis of the sulphate of soda, and find it contains as follows:—

Sulphate of soda	97·87 per cent.
Sulphate of lime	0·92 ,,
Chloride of sodium	0·53 ,,
Silica and peroxide of iron ..	0·47 ,,
Water and free sulphuric acid	0·21 ,,
	100·00

The cost of the furnace is much less than the cost of the ordinary pan and furnace, and the cost of labour is about one-half of that of the ordinary process. It is unnecessary that the labour should be skilled. The fuel used is

also less than in the pan and furnace of the ordinary process. There is, I think, some danger of the products of combustion interfering with the perfect condensation of the hydrochloric acid; but Messrs. Jones and Walsh tell me that they have no difficulty on this score, and that the gases of the chimney into which this furnace, as well as the other furnaces in their works draft, contains only from 0·010 to 0·015 of a grain of acid per cubic foot. Should the process work satisfactorily in this respect, I think there is no doubt that this is an important improvement in the decomposing plant of our chemical works.

Mr. James Mactear has recently patented some improvements in the manufacture of soda and potash which are now carried out at the St. Rollox Works, in Glasgow, and also in some works in Lancashire. Mr. Mactear's invention is applied chiefly to the charge in the revolving ball-furnace (which, by the way, is now steadily superseding the old hand-furnaces throughout the country), and consists in adding a small quantity (from 3 to about 10 per cent) of caustic lime to the mixture of sulphate of soda, coal, and carbonate of lime, at or near the end of the reaction. He recommends that the ball mixture at first placed in the furnace should contain carbonate of lime barely in excess of the chemical equivalent required. The advantages of this process are said to be that the ball soda dissolves readily; that the proportion of carbonate of lime being diminished, a much increased quantity of sulphate of soda may be decomposed in a furnace of a given size; that the time occupied in finishing each charge being reduced, an increased number of charges can in most cases be worked in a given time; and that there is a great saving of coal and carbonate of lime.

(To be continued.)

CORRESPONDENCE.

THE RIVERS' COMMISSION.

To the Editor of the Chemical News.

Sir,—The following occurs on page 505 of the Appendix to the Sixth Report of the Rivers' Commission:—

	Sulphate of Quinine Taken.	Nitrogen Calculated.	Nitrogen Found.
Expt. I. ..	1·95700	0·100	0·0996
Expt. II. ..	0·97850	0·050	0·0470
Expt. III. ..	0·09785	0·005	0·0060

And these quantities of sulphate of quinine do *not* contain the quantities of nitrogen which the Royal Commissioner, Dr. Frankland, thus represented them as containing. Dr. Frankland cited these experiments as establishing the validity of his process of water analysis; and I have remarked that what they really do show is that Dr. Frankland's process gives results in accordance with the expectation of the analyst, and not with the composition of the sample.

To this Dr. Frankland has made a very curious reply. He denies that he really used the above quantities of sulphate of quinine in the above experiments, and says that on reference to the label on a bottle in his possession he can now affirm that the quantities really employed were 1·5572, 0·7786, and 0·07786. He also offers some explanation of the way in which he came to say, in the Report, that he had used 1·957, 0·9785, and 0·09785. I cannot offer any suggestion as to the light in which this explanation should be viewed, and will content myself with recording it as simply as possible, only adding that Dr. Frankland's statement that he calculated the sulphate of quinine by a wrong formula is borne out by another reference to sulphate of quinine on page 506 of the Report, where 0·02 gramme of sulphate of quinine is affirmed to contain nitrogen equivalent to 0·00128 gramme of ammonia. In this last case the calculation (which is a miscalculation) is of very long standing, having been made by Dr. Frankland in the year 1868, and being merely reproduced in the Report of the Rivers' Commission.

I have now to criticise the experiments on sulphate of quinine, assuming the correctness of the explanations given by Dr. Frankland and Mr. Thorp, who, as it would seem, made the experiments in question. The sulphate of quinine ought not to have been taken hydrated, but carefully dried. Of this Mr. Thorp appears to be partially, but only partially, sensible. He is, as his letter shows, at great pains to prove that whether hydrated sulphate of quinine contains 7, 7½, or 8 atoms of water of crystallisation makes no sensible difference in the percentage of nitrogen; but he altogether overlooks the difficulty which arises from the extreme instability of the hydrated compound, which, indeed, gives up its water at ordinary temperatures if only the air in contact with it be dry. For anything that Mr. Thorp knows to the contrary, his sulphate of quinine, which he is pleased to regard as combined with some 15 per cent of water of crystallisation, may have contained only 5 per cent of water: and, accordingly, when he imagined he was dealing with 0·100 of organic nitrogen, and obtained experimentally 0·0996 of nitrogen, he may have been dealing with 0·110 of nitrogen. Thus, conceding to Dr. Frankland and Mr. Thorp the explanations which they have furnished after the objections to the Report of the Royal Commissioners have been pointed out to them, the sinister correspondence between expectation and result still remains, although not in so striking a form.

The extreme gravity of this "sulphate of quinine episode" may be judged of when it is considered that these experiments are the only evidence, or semblance of evidence, as yet offered by Dr. Frankland in favour of the validity of the process of water analysis which, in his capacity of Royal Commissioner, he has employed—and employed exclusively—in the very important investigations which the Crown had commissioned him to undertake. His method of water analysis, as is notorious, has met with general condemnation at the hands of chemists; and, with the sole exception of these experiments on sulphate of quinine, everything that he has published concerning his process has been a demonstration of its utter untrustworthiness and impracticability.—I am, &c.,

J. Alfred Wanklyn.

LIVERPOOL SODA TESTS.

To the Editor of the Chemical News.

Sir,—I was glad to see that Mr. Pattinson has called the attention of the Newcastle Chemical Society to the discrepancy between the reports of Liverpool chemists and those in other parts of the kingdom on the examination of alkalies. It has been, and is, the constant source of annoyance to many analysts, and myself amongst the number.

During the past year I have been several times called upon to report on samples of soda-ash against a Liverpool chemist, and my result has been invariably lower than his. In fact I have found it necessary, in order to avoid misunderstanding here, to report result in three distinct forms:—

(1.) Per cent real soda.
(2.) Per cent commercial standard.
(3.) Probable test in Liverpool.

I think that the existence of a commercial standard, in contradistinction to the actual percentage of soda, is a disgrace to our analytical system, and would long since have been done away with were it not that the greater number of analysts interested in the matter are employed by manufacturers, to whom the retention of the old equivalent of sodium is an advantage.

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pon enquiry in Liverpool I found that it is the custom t the analyst shall report only whole numbers, so that oda-ash containing under 49½ is reported 49 per cent, l over 49½ per cent is reported 50 per cent. Therefore e probable test in Liverpool is the amount of soda cording to commercial equivalent, with sufficient added make it a whole number. The various reports on the ne sample of soda-ash well illustrate this:—

	Sample Soda Ash.	Commercial Test. Per cent.	Real Soda. Per cent.
	Seller's chemist, Liverpool ..	55·00	—
me	Buyer's chemist	53·00	—
nple	My own report	52·68	52·00
	Another Manchester chemist	52·54	51·82

Of course if we followed the practice of doing away th decimals we should report 53 per cent.

I have also examined the sample taken from another t by the analyst's *employés*, and have compared it with mples taken from the same lot by the buyer's men, with sult as follows:—

mple taken by seller's chemist—

	Commercial Test. Per cent.	Real Soda. Per cent.
His report	51·00	—
My own report	50·00	49·4
Sample of same lot taken by myself	48·83	48·2

There is, unquestionably, great care required in taking mples, especially of soda-ash, which is lumpy; but ond the error possibly introduced in this way there ms to be another, even greater, produced by some un-lained difference in the method used by the seller's alyst in Liverpool from those of analysts in other ns.

This is a state of things that should no longer be erated, and I doubt not that a thorough examination of case would lead to the adoption of a universal true ndard and correct method—an extremely desirable re-, not only regarding the alkalies, but also other sub-stances used in large quantities in the various chemical manufactures.—I am, &c.,

GEO. WARNER, F.C.S.

Ardwick Bridge Chemical Works, Manchester.

TESTING SODA-ASH.

To the Editor of the Chemical News.

SIR,—I am pleased to find that "A Soap-Maker" has again called attention to the discrepancies in trade analysis.

With regard to the testing of soda-ash all the text-books I have consulted take the combining number of soda as 31, and not 32 (old notation), and recommend the test-acid to be made of such a strength that each cubic centimetre shall equal 0·031 grm. NaO.

Then suppose 2 grms. of the ash to have been taken, and 31·3 c.c. of the test-acid used, the true percentage of soda or total alkali would be 48·5, and not 50 per cent, as the maker's analyst—who uses 32 for soda—would return it.

Being a novice in analytical chemistry I am open to correction as to these figures.

Now, if my memory serves me, an "ash" of 50 per cent was selling at 11s. per cwt.—that is to say, at 2½d. for each unit of strength per cwt. Consequently, in the above instance, supposing a delivery of 20 tons to have been made, the value of the difference between 48·5 and 50 per cent on the lot would amount to £6 5s.

A friend of mine tells me that he has had many such tests made, and has found them to be fully worth the price paid for them; for even supposing that he did not make a claim on the manufacturers, it is of the highest importance to him that he should know the exact strength of his chemicals, in order to avoid waste.

It is said by some that buyers of "soda-ash" are quick to their own interests, and that they understand the "Liverpool test," as it is called, very well.

I hold in my hand a certificate of soda-ash which runs thus:—"We find the sample of soda-ash to contain of real alkali, as indicated by the burette, — per cent." Now I expect that many soda users do not know a burette when they see one; but even when its uses have been explained to them it may occur that its indications must, to a very considerable extent, be governed by the strength of the test-acid it contains.—I am, &c.,

NATRON.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de la Societe Chimique de Paris,
No. 10, November 20, 1875.

On a Very Sensitive Reagent for Detecting the Sulpho-Carbonates of Monosulphide (MS,CS_2) in Solution.—M. A. Mermet.—The reagent in question is the nickelate of ammonia. To make the test a drop of a solution containing $\frac{1}{10}$ of a pure salt of nickel (sulphate or chloride) is put in a test-tube with an excess of ammonia, and water enough to decolourise the liquid. A few drops of the solution in question is then poured in, when, if the smallest trace of sulpho-carbonate is present, a characteristic gooseberry-red colour is produced. If solutions of hepar are substituted for the monocarbonate a yellow tint is produced. Alkaline monosulphides give a brown or black according to the state of concentration; the sulpho-carbonates of bisulphide (MS_2,CS_2) (Gélis) give also a yellow.

Reactions for Distinguishing the Sulpho-carbonates of the Monosulphide MS,CS_2, from those of the Bisulphide, MS_2,CS_2.—M. A. Mermet.—If the reagents mentioned in the last notice are applied in a state of great concentration, and if the sulpho-carbonate is poured into an excess of the nickelate of ammonia, the results are as follows: Sulpho-carbonate of the monosulphides; a fine violet precipitate: sulpho-carbonate of the bisulphide; a yellowish brown precipitate.

On Certain double Metallic Sulpho-carbonates.—A. Mermet.—The author has isolated crystals of the double sulpho-carbonate of potassium and nickel.

On a Compound of Platinum, Tin, and Oxygen Analogous to the Purple of Cassius.—MM. B. Delachanal and A. Mermet.—Previously noticed.

Facts Relative to the Study of the Polyatomic Alcohols, Properly so-called. Application to a New Method of Obtaining Crystalline Formic Acid.—M. Lorin.—Already noticed.

Manner of Decomposition of Explosive Bodies Compared with the Phenomena of Supersaturation. MM. P. Champion and H. Pellet.—Already noticed.

Use of Fehling's Liquor.—MM. P. Champion and H. Pellet.—Recent experiments show that the standard of this liquid, which, in its normal state, does not change when used directly with a solution of glucose, undergoes, nevertheless, a certain modification which seems to be proportional to the time of keeping, when it is titrated with stannous chloride after the action of glucose (Weil's process).

On the Sulphides and Phosphides of Copper.—MM. P. Champion and H. Pellet.—The bisulphide is obtained

by leaving for several weeks copper turnings in contact with a solution of sulphur without bisulphide of carbon. The black precipitate obtained by adding a solution of the pentasulphide of potassium to a dilute solution of sulphate of copper yields the bisulphide on treatment with bisulphide of carbon. Proto-phosphide, Cu_2P.—The commercial proto-phosphide contains only 20 per cent of phosphorus instead of 32·8. The true proto-phosphide is obtained by adding this substance to an excess of neutral red phosphorus, mixing intimately, and heating to dull redness.

Decomposition of the Iodide and Chloride of Nitrogen.—MM. P. Champion and H. Pellet.—Already noticed.

Nitrocitric Acid.—MM. P. Champion and H. Pellet.—Nitrocitric acid is insoluble in ether, but soluble in alcohol in every proportion. If treated with anhydrous alcohol and gaseous hydrochloric acid it seems to give rise to the corresponding ether. Its formula is—

$$C_{12}H_7(NO_4)O_{14}.$$

Nitrostearic acid corresponds to the formula—

$$C_{36}H_{35}O_4(NO_4).$$

Notices.—By M. Eug. Durrwell.—Light acts upon a solution of iodide of potassium and sugar. Such a solution if kept in a white glass bottle soon grows yellow. If starched papers are prepared in the dark and steeped in this solution, and exposed to light under a negative proof, a positive is obtained, which only need be washed in plenty of water to stop the further action of the light.

Dinitro-naphthalin prepared by boiling naphthalin with fuming nitric acid always contains much mononitro-naphthalin which must be eliminated by means of alcohol. If fuming nitric acid is distilled with a mixture of naphthalin and broken glass the reaction is complete.

The ash of the best qualities of tobaco is white, consisting to a great extent of salts of soda and potash. During combustion these salts swell up, rupture the fibres, and render the combustion complete.

A good method of treating the Alfa fibre is as follows: Steeping; passing through lime water; washing; reduction to the state of tow between fluted rollers; bleaching with chloride of soda.

On Dichlorethylamin—M. J. Tschermak.—To prepare this substance the author distils hydrochlorate of ethylamin with chloride of lime, obtaining a very fluid oil, which passes over entirely between 75° and 95°.

Correspondence from St. Petersburg (September 1, 1875).—M. W. Louguinine.—The fifth number of the *Journal de la Société Chimique Russe* contains the account of the session of the Society of April 3 (15).

M. Zinine announced that by heating oxylepiden, $C_{28}H_{20}O_2$, with alcohol and caustic soda it is transformed into its isomer, octahedric oxylepiden.

MM. Beilstein and Kourbatoff announce that the $mC_6H_3Cl(NO_2)_2$ yields $C_6H_3Cl(NO_2)H_2N$ in the shape of yellow needles, fusible at 124° to 125°.

M. Mendeleef, on behalf of M. Setschenoff, described his experiments on the absorption of CO_2 by saline solutions.

M. Wladowski gave the result of his experiments on the use of SO_2 in the production of brandy from grain. He does not confirm the opinion that this gas facilitates the conversion of starch into glucose.

M. Alexeef described his experiments on the solubility amylic alcohol in water at different temperatures.

M. Wroblewsky discussed the constitution of the derivatives of benzin.

M. Menschoutkine, on behalf of M. Barsilofsky, described a new nitro-derivative of toluen.

On behalf of M. Schihoutzky he communicated the result of researches on the azo compounds obtained on setting out from dinitro- and iso-dinitro-phenyl.

On behalf of M. Remy he announced that in the action of potassium cyanide on bromal hydrate dibrom-acetic acid is formed.

The fifth number contains, also, memoirs on the brom-oxy-butyric and di-oxy-butyric acid, by MM. W. Petrieff and Eguis; the papers of M. Zinine on derivatives of oxylepiden; of M. Wladowski on the use of SO_2 in the manufacture of grain-spirit; of M. Trapp on a new camphor obtained from the flowers of *Ledum palustre*; and on the absorption of carbonic acid by saline solutions by M. Setschenoff.

Correspondence from St. Petersburg (September 10, 1875).—The sixth number of the *Jonrnal de la Société Chimique Russe* contains account of the session of May 1 (13) 1875.

M. N. Menschoutkine described his researches on the salts of dialuric acid.

M. Potylytzine communicated a paper on the mutual displacement of the haloids. When a molecule of bromine reacts upon a molecule of a chlorinated compound the amount of Cl displaced increases proportionately to the weight of the metal.

M. D. Pavaloff announces that in order to prepare the acetons by the action of the zinco-organic compounds upon acid chlorides, it is necessary to take these bodies in the proportion of 2 molecules of the chloride to 1 of the zinco-organic compound.

M. Lebedeff described the condensation of amylen obtained by M. Flawitzky.

M. Beilstein, on behalf of M. Lietny, gave an account of the action of iodine in alcoholic solution upon sulphurea.

M. Lavrinovitsch announced that the reduction of methyl-ethyl-aceton yields well crystallised pinacon.

M. Hemilian announced that he had found notable amounts of ethylic alcohol in the liquid which passes over between 75° and 85° in the distillation of crude wood-spirit.

M. Lioubavine gave an account of glyoxalin, and of a new method of preparing glyoxal.

M. Menschoutkine, on behalf of M. Jazoutkovitch, described the action of oxygen upon coal and paraffin.

Les Mondes, Revue Hebdomadaire des Sciences, No. 15, December 9, 1875.

This issue contains no chemical matter.

M. Reimann's Farber Zeitung, No 46, 1875.

This issue contains receipts for a blue on half-woollen tissues, a dark green on half-woollen garments; an ordinary and a fast scarlet on woollen yarns; a chamois, a chocolate, and a brown on cotton yarns.

NOTES AND QUERIES.

Loan of Diagrams.—Is there any place in London where I could obtain on loan, for illustrating a lecture, some diagrams on composition and impurities of water, classifications of water, and as described in Parkes's "Hygiene?" Any information on this point will greatly oblige, C. H. L.

Manufacture of Stearin.—Can any of your readers give me reliable information (for scientific purposes) whether in the manufacture of stearin the decomposition with lime under high pressure is still practised, or whether the only process practically in use is that by distillation or by decomposition with water? Also, if possible, for what reasons the old methods have been given up? Also, what is the yield of glycerine by the methods now in use?—George Lunge.

TO CORRESPONDENTS.

Dr. Morgan's case.—We have received certain letters and documents relative to this case and testifying in favour of Dr. Morgan's professional skill. Our comments, it will be remembered, were based simply on his extraordinary statement—as reported in the *Chemist and Druggist*—that train-oil was of mineral origin. We are happy to learn that Dr. Morgan formally denies having ever given such an answer. We submit, however, that if Dr. Morgan found himself falsely accused in the public papers, his wisest course would have been to communicate with us at once. In the absence of any facts to work upon we could not declare the report erroneous. We strongly advise Dr. Morgan, above all things, to get rid of that nervousness which appears to have been the cause of the unpleasant scene in court.

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THE CHEMICAL NEWS.

Vol. XXXII., No. 1835.

REMARKS IN CONNECTION WITH THE DISCOVERY OF GALLIUM.

By M. D. MENDELEEFF.

In 1869 the author announced the following law, called "periodic." "The properties of simple bodies, the constitution of their combinations, as well as the properties of the latter are periodic functions of the atomic weights of the elements."* Among the applications of this law may be cited the following.

This law constitutes the basis of the complete system of the elements:—

Series	First Group.	Second Group.	Third Group.	Fourth Group.	Fifth Group.	Sixth Group.	Seventh Group.	Eighth Group.
	—	—	—	RH_4	RH_3	RH_2	RH	(R_2H)
	R_2O	RO	R_2O_3	RO_2	R_2O_5	RO_3	R_2O_7	(RO_4)
1	1 H							
2	Li 7	Be 9	B 11	C 12	N 14	O 16	F 19	
3	23 Na	24 Mg	27 Al	28 Si	31 P	32 S	35 Cl	
4	K 39	Ca 40	? 44	Ti 48	V 51	Cr 52	Mn 55	Fe 56, Co 59, Ni 59, Cu 63
5	(63 Cu)	65 Zn	68 ?	72 ?	75 As	78 Se	80 Br	
6	Rb 85	Sr 87	Yt 88	Zr 90	Nb 94	Mo 96	? 100	Ru 104, Rh 104, Pl 106, Ag 108
7	(108 Ag)	112 Cd	113 In	118 Sn	122 Sb	125 Fe	127 I	
8	Cs 133	Ba 137	?Di 138	Ce 140	—	—	—	Os 195, Ir 197, Pt 198, Au 199
9	—	—	—	—	—	—	—	
10	—	—	Er 178	?La 180	Ta 182	W 184	? 190	— — — —
11	(199 Au)	200 Hg	204 Tl	207 Pb	208 Bi	—	—	
12	—	—	—	Th 231	—	U 250	—	— — — —

The periodic law requires the change of the atomic weights of some metals not yet sufficiently studied:—

	Atomic Weights of Metals and Formulæ of their Oxides.		
	Numbers received.	Numbers proposed.	
Indium	$75InO$	$113In_2O_3$	The specific heat of indium determined by Bunsen and by the author (*Bull. de l'Academ. de St. Petersbourg*, viii., 45) confirm this change.
Uranium	$120U_2O_3$	$240UO_3$	MM. Rammelsberg and Roscoe (*Ber. Deutsch. Chem. Gesell.*, v., 1003, and vii., 1131) accept the proposal.
Cerium	$92CeO$ Ce_3O_4	$138Ce_2O_3$ $Ce\,O_2$	The specific heat of the metal (*Bull. de l'Academ. de St. Petersbourg*, viii., 45) and the composition of its salts (*Leibig's Annal.*, clxviii., 46) seem confirmatory.
Thorium	$116ThO$	$232ThO_2$	MM. Chydenius and Delafontaine have previously proposed the same change.
Yttrium	$60YO$	$90Y_2O_3$	
Erbium	$114ErO$	$171Er_2O_3$	M. Cleve (*Ber. Deutsch. Chem. Gesell.*, viii., 129) accepts these formulæ.
Didymium (?) or Lanthanum (?)	$92RO$	$138R_2O_3$	

The periodic law indicates the gaps which still exist in the system of the known elements, and enables us to predict the properties of the unknown elements, as well as those of their compounds. Thus, for instance, there are two gaps in the groups III. and IV. of the fifth series. The author has named these undiscovered elements eka-aluminium, El, and eka-silicium, Es. The properties of the former according to the periodic law should be the following:—Its atomic weight will be El = 68; its oxide, El_2O_3; its salt will present the formula ElX_3. Thus its (only?) chloride will be $ElCl_3$, yielding on analysis 39 per cent of metal and 61 of chlorine, and will be more volatile than $ZnCl_2$. Its sulphide, El_2S_3, or oxysulphide, $El_2(S,O)_3$, will be precipitable by sulphuretted hydrogen, and insoluble in sulphide of ammonium.

The metal will be easily obtained by reduction; its specific gravity will be 5·9, consequently its atomic volume will be 11·5; it will be almost fixed, and fusible at a low temperature. It will not become oxidised in contact with the atmosphere, and at a red-heat it will decompose water. The pure metal melted will be slowly attacked by the acids and alkalies. The oxide, El_2O_3, will have the specific gravity 5·5, or thereabouts: it should be soluble in strong acids, form an amorphous hydrate insoluble in water but soluble in acids and alkalies. The oxide will form neutral and basic salts $El_2(OH,X)_6$, but not acid salts; its alum, $ElK(SO_4)_2 12H_2O$, will be more soluble than the corresponding salt of aluminium, and less crystallisable. The basic properties of El_2O_3 being more decided than those of Al_2O_3, and less than those of ZnO, it will be precipitable by carbonate of baryta. The volatility as well as the other properties of the saline compounds of El being the mean between those of aluminium and those of indium, it is probable that the metal in question will be discovered by means of spectrum analysis, as was the case with indium and thallium.

These characters of El have been obtained (*Journ. d*

* *Journal de la Soc. Chimique Russe*, t. i., p. 60. Also t. ii., (1870-71) of the author's work (in Russian) "Foundations of Chemistry." See Liebig's *Analen*, Supplement Band viii., p. 133, 1871.

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la Soc. Chimique Russe, 1871, iii., 47) by considering its place in the periodic system of the elements.

Series.	2nd Group.	3rd Group.	4th Group.	5th Group.
3. ..	Mg	Al	Si	P
5. ..	Zn	El	Es	As
7. ..	Cd	In	Sn	Sb

It must be further remarked that until the discovery of the periodic law it was impossible to predict the existence of metals still unknown, and to determine their properties.

M. Lecoq de Boisbaudran, having applied his new method of spectrum analysis, announces (*Comptes Rendus*, p. 493) the presence, in the blende of Pierrefitte (Pyrenees) of a new metal, which he names Gallium. The manner in which it has been discovered, the process of its separation (precipitation by H_2S before Zn), and certain properties described (precipitation by $BaCO_3$, solubility of the hydrate in ammonia, degree of volatility, &c.), render it probable that this new metal is eka-aluminium. If further research confirms the identity of the properties just assigned to eka-aluminium with those of gallium it will be an instructive example of the utility of the periodic law.

We may hope that the discovery of eka-silicium, $Es=72(EsO_2)$, whose presumed properties are laid down in *Liebig's Annalen*, Suppl. bd. viii., p. 171) will soon be effected. It should be sought for especially along with arsenic and titanium.—*Comptes Rendus.*

ON CERTAIN PROPERTIES OF GALLIUM.

By M. LECOQ DE BOISBAUDRAN.

After attempts, which the rarity of the material in question has rendered long and laborious, I have prepared the salts of gallium so pure as to give with the spectroscope, beside a magnificent spectrum of gallium, merely feeble traces of the zinc rays, Znα 144·62 and Znγ 150·05. Such a proportion of zinc is far below the limit of sensibility of ordinary reagents.

On examining the properties of pure salts of gallium I observed certain deviations from the reactions presented when gallium is mixed with much zinc. This is not surprising, but will require new researches, with which I shall occupy myself when I have recruited my stock of gallium, which has been completely exhausted by the experiments described below. After referring to the properties of a mixture of gallium and zinc, as described in *Comptes Rendus*, September, 1875, p. 495 (and in the Chemical News, vol. xxxii., p. 159), the author then proceeds to give the reactions of pure gallium:—

The electric spectrum of chloride of gallium, slightly concentrated, is very brilliant. The ray 417 is much more intense than the ray 404. I have not observed any other ray attributable to gallium; there is certainly none of notable intensity, at least in the physical conditions under which I operated. The colour of the spark in chloride of gallium is a fine light violet. In the gas-flame I only obtained the ray Gaα 417, very feeble and fugitive, even with a salt which gave a brilliant electric spectrum. The chloride and sulphate of Ga are precipitated by ammonia, but the precipitate is in great part soluble in excess. If the portion insoluble in ammonia is re-dissolved in hydrochloric acid, and the operation repeated, all the gallium may easily be obtained in an ammoniacal solution.

An ammoniacal solution of gallium sulphate or chloride, whether cold or hot, is precipitated by acetic acid in excess, except the liquid is extremely dilute. The same salts of gallium, when cold, are not precipitated by acid acetate of ammonia, but the reaction takes place on the application of heat. Gallium sulphate, evaporated and dried almost to the cessation of the escape of white sulphuric vapours, does not lose its solubility in water. Sulphate of gallium is also soluble in water at 60 per cent. I have obtained a salt which I believe to be ammonia-gallic alum. For want of a sufficient quantity I have been unable to analyse it and measure its angles, but its characters appear sufficiently distinct to warrant my conviction, subject to future verification. The alum in question is soluble in cold water, but on heating the alum is decomposed, and the liquid becomes turbid. This alum is not decomposed when heated with water mixed with acetic acid. It crystallises very readily in cubes and octahedra, presenting exactly the aspect of common alum, and the solution evaporated under the microscope behaves just like known alums. The crystals of gallium alum do not act upon polarised light between two Nicol prisms giving extinction. A small crystal of gallium alum was kept for some time under a layer of water, and then laid in a slightly supersaturated solution of ammonia-alumina alum. It grew immediately therein, and determined the crystallisation of the liquid. With an excess of ammonia gallium alum behaves like the other salts of this metal: a part of the oxide is thrown down, whilst the rest remains in solution. The very acid solution of Ga_2Cl_3 is precipitated by yellow prussiate. The ammoniacal solution of gallium sulphate is decomposed by the voltaic current. Metallic gallium is deposited on the platinum plate which serves as a negative electrode. The positive electrode is covered at the same time with a whitish film, formed by a pellicle which is easily detached from the platinum, and which is insoluble in a large excess of ammonia. In a first operation 1·6 milligrammes of gallium were deposited in four and a half hours on a platinum foil of about 185 square m.m. surface: the surface of the positive electrode was 877 square m.m. The battery was composed of five bichromate pairs (zincs $=17\times10$ c.m.) connected for tension. The specimen laid before the Academy weighs 3·4 milligrms., and was deposited in five hours forty minutes upon a surface of about 123 to 124 square m.m. The positive electrode was 877 square m.m. The current was furnished by ten bichromate elements, of the same size as above mentioned, and connected for tension. Electrolytic gallium forms a very adhesive layer; it is hard, and polishes very badly when rubbed with an agate burnisher. A better polish is acquired by strong pressure with the agate burnisher. The metal acquires then much lustre, and seems whiter than platinum. When the electric current is duly regulated gallium presents a fine matt surface, of silvery whiteness, finely granulated, and scattered over with small brilliant points, which the microscope shows to be crystals. Gallium deposited on a sheet of platinum does not become notably oxidised on washing with cold or boiling water,* nor when dried in the open air at temperatures bordering upon 200°. It decomposes water acidulated with hydrochloric acid when cold, and more rapidly when hot, with a brisk evolution of hydrogen. The salts of gallium used in my researches have been obtained from the blende of Pierrefitte, of which I have received an abundant supply from M. Malgor, the engineer of the mine. I have also detected the presence of the new metal in other ores of zinc, especially in a transparent blende from Santander, given me by M. Friedel. I believe that gallium will be found in all blendes, and hope soon to possess further information on this point. The gallium which I have extracted from the blendes comes really from these ores, and not from the metallic zinc (Vieille Montagne) used in the precipitations; for I have not obtained traces of gallium with quantities of this zinc greater than the amounts of blende required to show a very distinct spectroscopic reaction of gallium.

My latest researches have confirmed the smallness of the amount of gallium in blende. The extreme sensibility of the spectral reaction caused me to over estimate the quantities obtained. I do not think I exaggerate in saying that in my first observation I possessed at most 1-100 milligrm. of this new body, dissolved in a very small drop

* The polished surface, nevertheless, becomes slightly clouded after a few days, owing, doubtless, to a superficial oxidation.

of liquid. The spectral examination of so small a quantity would have been impracticable before the considerable reduction which I have made in the dimensions of the apparatus for obtaining electric spectra, and without my adoption of very small sparks. If, as I suppose, there is no error corcerning the nature of my gallium alum, the existence of this salt fixes the atomicity of the new element, and attributes to its oxide the same chemical function as that of alumina. The oxide of gallium will then be Ga_2O_3.

I have just received the *Comptes Rendus* for Nov. 22, containing M. Mendeleef's very interesting paper on the classification of the elementary bodies, and of gallium in particular. Questions of this kind have occupied me for a long time. I have special ideas on this subject, the substance of which I have deposited with the Institute in sealed packets. However, I have not wished to publish my hypotheses without having submitted them to experimental verification, and without having made some efforts to produce positive results which may confirm them, and permit me to perfect them. I shall return to M. Mendeleef's paper, but for the present I will merely say that the analogy of the spectra of N, Ga, and In struck me since my first observations. I have calculated the equivalent of gallium by applying my first spectral law. In consideration of the solubility of the oxide of gallium in ammonia, and of the impurity of the substance in my possession, I have thought it more prudent to lay before the Academy the facts which I have discovered, reserving for a future occasion an exposition of theoretical considerations. I ought likewise to say that I was ignorant of the description given by M. Mendeleef of the supposed properties of his hypothetical metal. I will even add that this ignorance has probably been favourable to me, for in spite of the incontestable merit of the theoretic ideas of M. Mendeleef, to whose views I am much disposed to give in my adhesion, and supposing the forecasts of this chemist verified altogether, I should have been led to seek for gallium in the precipitates formed by ammonia, and not, as I have done, in the ammoniacal solutions. In fact, the properties of the hypothetical metal ought to "present the mean between those of aluminium and indium," metals whose oxides are almost completely insoluble in ammonia.*

I consider it very probable that without the particular method followed in the present investigation neither the theories of M. Mendeleef nor my own would have for a long time led to the discovery of gallium.—*Comptes Rendus.*

ON NOXIOUS AND OFFENSIVE TRADES AND MANUFACTURES,†

WITH ESPECIAL REFERENCE TO THE BEST PRACTICABLE MEANS OF ABATING THE SEVERAL NUISANCES THEREFROM.

By H. LETHEBY, M.B., M.A., &c.;
Professor of Chemistry in the College of the London Hospital; late Medical Officer of Health and Public Analyst for the City of London; and President of the Society of Medical Officers of Health.

(Continued from p. 285).

LEAVING these, which are the most important operations whereby sulphuretted hydrogen and organic vapours are evolved, I proceed to a class of manufactures which are nuisances by reason of the irritating acid vapours and gases which they produce; and these may be classified under different heads.

(1.) *Those which generate muriatic acid gas.* Until comparatively recently (since 1863, when the Alkali Act came into operation) the production of carbonate of soda, or rather salt-cake, which is the first step of the process of manufacture, was one of the most offensive and destructive operations in the kingdom. For a distance of miles, indeed, around the *alkali works*, vegetation was blasted, and residential existence was almost impossible. Action upon action at law, therefore, for ruinous damages was the chief entertainment of the parties concerned, and it was a dire struggle between the farm and the factory. The effect of all this was seriously considered by the late Earl of Derby, who brought it under the notice of Parliament and obtained the Act of 1863, which compelled the manufacturer of alkali to condense no less than 95 per cent of all the muriatic acid derivable from the materials which were used; and last year the Act was amended so as to bring other manufactories, as copper works, where salt is the agent employed, as well as vitriol works, &c., under the Act. The amount of muriatic acid escaping from the alkali works is also restricted, not merely to 5 per cent of the quantity made, but to one-fifth of a grain per cubic foot of the gas or air leaving the works. There is hope, therefore, that still further improvements will be effected in these operations.

The method of making salt-cake is first to treat common salt with sulphuric acid in pots (called saturating pots) at the head of a reverberatory furnace, and then to rake out the mixture upon the bed of the furnace, where it is subjected to a red heat for two or three hours. The muriatic acid, which is copiously evolved from the materials, is carried by pipes and flues to a high and capacious condensing tower, where it meets a stream of cold water flowing downwards over the coke with which the tower is packed. The draft of the tower is caused by the furnace shaft, into which the residuum of unabsorbed gas enters. In this way a liquid acid of 28° Tw. (1·140 sp. gr.) is obtained, and this is used with oxide of manganese for making chlorine in the production of chloride of lime (bleaching-powder). The red-hot salt-cake, when drawn from the furnace into iron barrows, is highly charged with muriatic acid, which it gives off in copious fumes, so that the workmen are obliged to take some precaution to prevent its effects. The fumes, however, do not extend to any great distance—not many yards from the furnace—and they might be checked altogether by Dr. Roscoe's contrivance of raking the hot furnace charge of salt-cake into a brick chamber underneath the furnace, and provided with an opening into the flue. All these arrangements are, however, under the immediate supervision of inspectors appointed by Government, and they are generally managed with great precautions.

Not so careful, as a rule, are the manufacturers who extract *copper from spent pyrites by means of common salt.* These pyrites, after having been used by the oil of vitriol maker in generating sulphurous acid, contain from 2 to 4 per cent of sulphur and a small proportion of copper. They are crushed into a coarse powder and mixed with common salt (3 cwts. to a ton of pyrites), and they are roasted in a reverberatory furnace for several hours, whereby muriatic acid gas and a little sulphurous acid escape; and as the manufacturers have not hitherto been under any legislative obligations as regards the proportion of acid evolved, they have generally let it go freely into the chimney shaft. They will, however, be compelled to condense it by means of coke towers, as is done in alkali works.

Common bottle glass is now made from silica and common salt, which are fused together in huge melting pots, and thus immense quantities of muriatic acid gas are discharged into the air.

In like manner the use of common salt as a means of *glazing the commoner kinds of pottery* (brown ware bottles, jugs, pans, pipes, &c.,) is a cause of great offence at Lambeth and elsewhere, from the amount of muriatic acid discharged into the atmosphere.

* Oxide of indium is generally considered almost insoluble in ammonia, a property which is utilised in its separation. As for alumina, its solubility in ammonia, though slight, is sensible. It remains to be seen whether the great delicacy of the spectral reaction of gallium, and the minuteness of the quantities upon which I have operated, have not caused me to over-rate the relative solubility of Ga_2O_3 in NH_3.

† A Paper read before the Society of Medical Officers of Health. Communicated by the Author,

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Brick burning and cement burning are also sources of nuisance from the same cause. In the case of bricks, the salt comes from the cinders (household breeze) used in the burning, which become charged with salt in the dust bins of houses. In the case of cement burning the salt is derived from the mud of the tidal rivers, from which, with chalk, the cement is made. In all these instances, when salt is heated with silica or clay, the alkali combines with the fixed acid and forms a fusible glass or glaze, while the volatile acid (muriatic) escapes. The remedy with the potter and cement manufacturer is to condense the fumes in a proper scrubber; and with the brick-maker the remedy is to use coke breeze, or household breeze that has been well weathered and washed by the rain.

(2.) *Nuisances occasioned by the escape of sulphurous acid.* This is most marked in the manufacture of oil of vitriol, which is always produced from the vapours of burning sulphur. The sulphur employed is either crude native sulphur or pyrites (which contains 35 to 50 per cent sulphur), and the spent oxide from gas-works (which is a mixture of from 40 to 60 per cent sulphur with hydrated oxide of iron and sawdust). The furnaces for burning these several forms of sulphur are very different in their construction, but when properly managed the combustion of the sulphur should be complete, or nearly so, and all the fumes should be carried without escape into the leaden chambers. These chambers are of great capacity, as from 30,000 to 100,000 cubic feet, and they not only receive the fumes of the burning sulphur (sulphurous acid), but they likewise receive nitrous fumes from a pot or small stove containing nitre at the back of the sulphur furnaces, as well as jets of steam which are blown into the chambers from a boiler. The chemical reactions which take place in the chamber are not precisely understood, but the practical effect of them is that the sulphurous acid, or anhydride (SO_2) with nitrous fumes (N_2O_3) and steam or water (H_2O) form sulphuric acid (H_2SO_4) and nitric oxide (N_2O_2). The former is precipitated to the bottom of the chamber, where it is dissolved in the water present, and the latter (nitric oxide) escapes to take oxygen from the air of the chamber, and so again forms nitrous fumes for a similar reaction. The nitrous fumes, therefore, are merely the purveyors of oxygen from the air to the sulphurous acid, and would, in the presence of oxygen alone, act indefinitely; but as the oxygen of the air in the chamber is associated with nearly four times its volume of nitrogen, it follows that as the former is abstracted the latter accumulates, and must be replaced by fresh atmospheric air. Hence the necessity for a current of air through the chambers, and this current of air carries with it notable proportions of sulphurous acid and nitric oxide, which, escaping into the atmosphere by the chimney shaft, are the cause of injury to vegetation and annoyance to the neighbourhood. The extent of this escape of noxious gases may be determined in several ways:—First, the relation between the quantity of materials used and the amount of oil of vitriol produced. Theoretically, 100 parts of sulphur should produce 306·25 parts of monohydrated sulphuric acid (H_2SO_4); but in practice it varies from 200 to 294 parts. The nitre also employed at the works ought not to exceed 2 parts by weight for every 100 parts of sulphur, but in reality it is rarely less than 4 parts, and it ranges from this to 12 parts or more. In those cases where spent oxide is used as a source of sulphurous acid, the quantity of nitre is rarely less than 7 per cent. Secondly, the amount of escape may be ascertained by examining the gases which pass from the chambers to the chimney shaft. There is always a means of doing this with considerable accuracy by abstracting the gases from the flues which connect the chambers with the general shaft. According to Dr. Roscoe, a cubic foot of these gases ought not to contain more than 1 grain of sulphur in any form; whereas, in badly managed works, the quantity may reach to 16 grains per cubic foot. The air of the chimney shaft, also, should not contain more than a quarter of a grain of sulphur per cubic foot, and of this a little more than half is derived from the coke or coal burnt in the furnaces. The remedies for this waste are twofold:—First, the exercise of care in the conduct of the works—regulating the sulphur furnaces so that no fumes escape therefrom, and a proper supply of air is admitted into the chambers. In well managed works it is customary to have glass pressure syphons communicating with the exterior of the various chambers, so as to watch and regulate the condition of them. The chambers, also, should be completely surrounded and enclosed with casing, having a gallery or passage-way round, so that any and every escape may be at once detected. Second, the effluent gases should be passed through scrubbers charged with absorbent liquids. Oil of vitriol, for example, flowing through the scrubber in a small graduated stream, will absorb the oxides of nitrogen, as suggested by Gay-Lussac; and water will take up any trace of sulphurous acid. Both of these liquids can be made to flow into the leaden chamber, and be thus utilised. At several oil of vitriol works which I have inspected it is the practice to carry the gases, which may by accident escape from these absorbent agents, through a lime purifier, before they go to the tall chimney shaft; and in this way all chance of annoyance is prevented.

The sulphuric acid which collects at the bottom of the leaden chamber is continually drawn off at a sp. gr. of 1·600. This is called "chamber acid," and as it is too weak for general purposes, it has to be concentrated by evaporation. This is done to a certain extent in leaden pans, where it reaches a gravity of about 1·720, making the "brown acid" of commerce; and the further concentration is effected in vessels of platinum or glass, where the acid obtains a gravity of from 1·845 to 1·854, which is the "oil of vitriol" of English commerce. All of these operations are offensive, from the escape of acid, unless they are well conducted.

It is necessary, therefore, in the management of oil of vitriol works, to take care—

First, that the sulphur furnaces are burning properly, and are not permitting any escape of sulphurous acid.

Second, that the leaden chambers and flues therefrom are constantly sound and air-tight.

Third, that the gases in the flues from the leaden chamber do not contain above 1 grain of sulphur per cubic foot.

Fourth, that these gases are passed through a water scrubber and an oil of vitriol scrubber in succession, before they go to the chimney shaft; and

Fifth, that the evaporation and concentration of the chamber acid, as well as the brown acid, be conducted without the escape of offensive gases.

Another source of annoyance from the escape of sulphurous acid, is where the *noble metals are refined* by boiling the alloys in oil of vitriol. This, however, is easily guarded against by conducting the operations in closed vessels and carrying the evolved gases through an alkaline solution, whereby valuable sulphites and hyposulphites may be obtained for commerce.

Lastly, there is often a considerable escape of this gas from the chambers where *bleaching operations* are carried on by means of burning sulphur, as, for example, in the bleaching of woollen goods, straw bonnets, hair, hops, nuts, spice, &c.; and in these cases the refuse gas should be carried through some absorbent liquid or solid (lime for example) by means of a fan or draught to a chimney.

(3.) *There are certain manufacturing operations which are attended with the escape of nitrous fumes* and are exceedingly irritating and offensive. As I have stated, these fumes may escape from badly managed *vitriol works*. They are also caused when *oxalic acid* is produced from saccharine matters by the action of nitric acid. *Refiners* also discharge large quantities of the acid into the air when they treat the alloys of the noble metals with nitric acid. The *makers of tin and iron* liquors, of *nitro-benzol*, and of *picric acid*, are likewise producers of these irritating

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fumes when they act upon the several materials with strong nitric acid. The remedy for the nuisance is the carrying on of such operations in closed vessels, and the conveyance of the nitrous fumes through water or an alkaline liquid (milk of lime) by which the red fumes are entirely absorbed or arrested.

In the manufacture of *bleach-powder* (chloride of lime) there is occasionally an escape of chlorine, but it is nearly always accidental unless the works are managed with great carelessness. The chlorine is generally made from the liquid muriatic acid, which flows from the condensing towers at the alkali works. The acid has a gravity of from 25° to 28° Tw. (1·125 to 1·140) and it is run into a still upon peroxide of manganese, and stirred and heated so as to promote chemical action. The chlorine which is thus evolved is passed into chambers containing layers of finely slaked lime, slightly damp, to the depth of from 3 to 6 inches. The residual liquor in the still, which is a solution of chloride of manganese and free acid, of the strength of from 26° to 30° Tw., is, in many cases, not allowed to run to waste and be a cause of annoyance, but is treated with lime and air to recover the oxide of manganese. The first step of the process is to neutralise the free acid of the liquor by means of chalk (carbonate of lime), which does not decompose or act upon the chloride of manganese. When the effervescence is over and the liquor has become clear by subsidence, the supernatant solution of chloride of manganese and chloride of calcium is drawn off into another vessel called an "oxidator," where it is subjected to the action of a proper proportion of cream or milk of lime, which decomposes the chloride of manganese and forms a precipitate of oxide of manganese. Air is now blown into the mixture until the protoxide of manganese is converted into peroxide, and when this is complete it is allowed to settle, and the solution of chloride of calcium is either utilised or is run away to waste. Chlorine is also made from gaseous muriatic acid by the oxidising action of the air at a high temperature. In this case the muriatic acid gas from the salt-cake furnaces is carried with atmospheric air into chambers heated to a low red heat (about 1000° F.), and here and in another chamber called an "oxidator," the hydrogen of the muriatic acid is oxidised and the chlorine set free. The mixed gases and vapours of chlorine, muriatic acid, and steam, are passed through condensers to cool them, and the moist chlorine is finally dried in a sulphuric acid scrubber, and then conveyed to the lime chambers. This method of generating chlorine requires care and attention, as the high temperature of the decomposing apparatus is very likely to lead to fissures and cracks in the apparatus, which will permit an escape of irritating gases.

(To be continued.)

RAPID MODE OF DETECTING THE ADULTERATION OF BUTTER WITH OTHER FATS.

By J. W. GATEHOUSE,
Lecturer on Chemistry at the Somersetshire and Bath Proprietary Colleges.

The following method is based on the insolubility of potassium stearate in alkaline solutions, when the stearate has been produced at high temperatures.

Before the application of the test, it is essential that all curd, butter-milk, and salt be removed, and for this purpose the butter should be thoroughly washed in boiling water, and, if necessary, dissolved in ether.

Take about 20 grains of the butter, place it in a large test-tube—dimensions about 6 × ¾ inch—and fill the tube one-third full with water, boil thoroughly, and allow to stand till the fat has acculated at the top.

Two modes now present themselves—first, either to dissolve the fat in ether, and saponify after evaporation; or, secondly, and I think more conveniently, extract the lower layer of liquid by means of a pipette, which may be readily effected with a minimum of loss in the following way:—

Draw out a piece of thin glass tubing, sufficiently long to reach to the bottom of the tube, to a fairly fine point, but not too fine, and bend the top to an obtuse angle. Whilst the butter is still liquid, insert this nozzle to the bottom of the test-tube by placing the finger over the upper end, so that no liquid may get in till it reaches the bottom of the tube. Allow it, now, to remain till the butter is cold and fairly set, when, by means of an inch of small caoutchouc tubing, attach to a sufficiently large pipette, and withdraw the whole of the liquid, the butter will, if sufficiently cooled, remain in the middle of the tube.

This process can be repeated till the washings show the absence of chlorides when tested with nitrate of silver.

The saponification is effected by heating the purified butter with from one-third to one-half its own weight of solid potassium hydrate perfectly free from salts of sodium (the best being the hydrate purified by alcohol) to a temperature above 420° F.

Eight grains of potassium hydrate easily saponifies the 20 grains of butter.

The heat should be applied gently at first, and when the frothing is becoming less, a higher temperature may be applied till no further apparent action occurs, and a porous mass remains at the bottom of the tube.

Should the butter be pure, the colour of this mass will be, at the utmost, light yellow interspersed with a few light brown patches; but should the butter be adulterated to any extent, it may be almost black. Two much reliance, however, must not be placed on the colour.

It is essential that the ultimate temperature during saponification be kept at above 400° for some minutes, else the potassium stearate formed will be soluble instead of insoluble in the alkaline solution. For this purpose in the first experiments it is advisable to use a bath of molten tin or lead, but having once noticed the series of reactions which occur, the flame of the Bunsen burner can be used quite as conveniently and more advantageously.

Having allowed the tube and its contents to cool, boil the saponified mass with successive portions of distilled water till 6oz. or (200 cubic centimetres) altogether have been used. The absolute amount of water used is not material, but having once determined on the amount, it must be rigidly adhered to.

A portion of this solution poured into a test-tube half an inch in diameter will present only a faint opalescence if the butter is pure, but a decided opacity if impure, the degree of opacity depending on the amount of adulteration.

In order to determine the amount of adulteration in any sample, a pure butter should be first obtained from cream, which is easily effected by churning cream for from 15 to 30 minutes in a wide-mouth bottle, and adding to separate portions of its known percentages of lard, &c.

Saponify each of these as stated above, and cork them up in tubes of equal diameter, labelling each with the percentage of lard it contains.

On comparing them, it will be seen that 2 per cent of lard can be clearly indicated.

When a butter is analysed, all that remains to be done is to saponify, make up the solution to the correct amount, and after cooling, pour out a portion into the tube, when comparison is easily made with the specimen tubes.

It is possible to weigh the amount of potassium stearate thus produced; but as the process of washing is tedious and the weighings never absolutely accurate, the comparison method is to be preferred.

Royal School of Mines.—The third Annual Dinner of the Students of the Royal School of Mines was held on Friday, the 17th instant, at the St. James's Hall Restaurant. In spite of the unavoidable absence of many who had expressed their intention of being present, the Students, Associates, and Professors mustered to the number of nearly sixty.

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PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 16th, 1875.

Professor ABEL, F.R.S., President, in the Chair.

AFTER the names of the visitors had been announced, and the minutes of the previous meeting read and confirmed, Messrs. J. F. M. Harris Stone, R. L. Barnes, and F. C. Desvignes were formally admitted Fellows of the Society. The names read for the first time were those of Messrs. J. Watson, W. Galbraith, D. E. Brown, A. H. Scott White, M.A., G. Wilson M.A., W. Foulkes Lowe, S. W. Nockolds, G. Haycraft, F. J. Lloyd, H. Allen, F. Isenbart Scard, H. Bailey Dixon, and W. A. Smith. For the third time—Messrs. William Harkness, William Auld Stewart, Alfred Smetham, John Davies Mucklow, H. G. Ivey, Bernand Shirley Dyer, A. E. Evans, George Cheverton, Arthur Talbot, and George Herbert Bailey, who were balotted for and duly elected.

The first paper, "*Narcotine, Cotarnine, and Hydrocotarnine*," by Mr. G. H. BECKETT and Dr. C. R. A. WRIGHT, was read by the latter. The authors, on repeating the experiments of Matthiessen and Foster, of fusing opianic acid with caustic potash, found that, as they had stated, it was converted into meconin and hemipinic acid, but that the latter contained a small quantity of another acid, which gave a blue tint with ferric chloride, and which was methylnormeconin, $C_9H_8O_4$. On heating dry sodium hemipinate with dry soda-lime a heavy oil was obtained, which on examination proved to be dimethyl-pyrocatechin, the reaction being—

$$(COOH)_2C_6H_2(OCH_3)_2 = 2CO_2 + C_6H_4(OCH_3)_2.$$

When treated with strong hydriodic acid the dimethyl-pyrocatechin is converted into pure pyrocatechin, with simultaneous formation of methyl iodide. If hemipinic acid is fused with caustic potash, the following reaction takes place—

$$C_{10}H_{10}O_6 + 3KHO = C_7H_5O_4.K + K_2CO_3 + 2CH_4O,$$

potassium protocatechuate being produced: these results conclusively proving that hemipinic acid is a carboxyl-dimethyl-protocatechuic acid $(COOH)_2C_6H_2(OCH_3)_2$. It seemed probable from the results obtained with hemipinic acid that on heating sodium opianate with soda-lime, methyl-vanillin, $(COH)C_6H_3(OCH_3)_2$, would be produced, and on making the experiment such was found to be the case, although the yield was comparatively small. By the action of oxidising agents methyl-vanillin is converted into dimethyl-protocatechuic acid, $COOH.C_6H_3(OCH_3)_2$, and when treated with hydrochloric acid it yields vanillin, $COH.C_6H_3(OCH_3)(OH)$, and methyl-chloride. The action of hydriodic acid on hemipinic acid has also been studied by the authors, who find that methyl-norhemipinic acid, $(COOH)_2C_6H_2(OCH_3)(OH)$, is first produced, and that by a continuance of the action this is then converted into methyl-protocatechuic acid and finally into protocatechuic acid: somewhat analogous results are obtained with hydrochloric acid. The decomposition which methyl-norhemipinic acid undergoes when fused with potassic hydrate results, as might be expected, in the formation of protocatechuic acid, and when heated alone it yields methyl-protocatechuic acid. The concluding portion of the paper describes the action of fused potash on meconin, the product of the reaction being methyl-normeconin, $C_9H_8O_4$; and when this is fused with a large excess of potash, protocatechuic acid is obtained, the methyl-normeconin being probably first oxidised to methyl-norhemipinic acid, which is subsequently converted into protocatechuic acid. Dr. Wright said he might also state that he had succeeded in obtaining a new opium alkaloid, *oxynarcotine*, the formula of which was—

$$C_{11}H_{11}(CH_3)NO_3.CO.C_6H_2(COOH)(OCH_3)_2,$$

resembling that of narcotine, except that it contained the group COOH instead of COH.

Dr. ARMSTRONG said he could only express his conviction that the evidence adduced for the formula of hemipinic acid and opianic acid was most complete and conclusive, but he could not say as much for that of meconin, resting as it did chiefly on the action of caustic potash on the substance. The evidence for the formula of narcotin, also, was not quite conclusive, one point being that although when heated with water, meconin, and hydrocotarnine, are the only products,—

$$C_{22}H_{22}NO_7 = C_{10}H_{10}O_5 + C_{12}H_{13}NO_3.$$

Dr. Wright had assumed that opianic acid was first formed and then reduced to meconin, but he had never proved that opianic acid could be reduced to meconin.

Dr. WRIGHT replied that if he attempted the reduction of opianic acid with the ordinary reagents, such as zinc and sulphuric acid it was highly improbable that that agent would reduce the carboxyl group, COOH, in opianic acid $(OCH_3)_2(COH)C_6H_2.COOH$.

Dr. ARMSTRONG conceived that the formula adopted by Dr. Wright was the most probable, the results he had himself obtained corroborating this view, but he must say the experimental evidence was not conclusive.

Dr. H. E. ARMSTRONG then read two communications by himself and Mr. G. HARROW, the first of which was "*On the Action of Potassic Sulphite on the Haloid Derivatives of Phenol.*" When trichloro-phenol is heated at 170° C. with a concentrated aqueous solution of potassic sulphite, a mixture of potassic dichloro-phenol-sulphonate and chloro-phenol-disulphonate is obtained, which, when acted on by nitric acid, yields dichloro-ortho-nitro-phenol and para-chloro-diortho-nitro-phenol, proving that in trichloro-phenol, which has the constitution—

$$Cl : Cl : Cl : = 1 : 4 : 6,$$

the two atoms of chlorine in the *ortho* position are displaced. When, however, the experiment is reversed, and the sulpho groups in ortho-chloro-phenol-*ortho*-*para*-sulphonic acid is displaced by chlorine, the two possible dichloro-phenol-sulphonic acids are formed, namely, dichloro-phenol-*ortho*- and dichloro-phenol-*para*-sulphonic acids. Mono- and dichloro-phenol are also readily acted on by potassic sulphite, and can also be converted into sulpho-salts by its action. Tribromo-phenol behaves very differently. When heated to 170° with potassic sulphite very little sulpho-salt is produced, it being chiefly converted into an amorphous body insoluble in alkalies and in alcohol, and which has not, as yet, been obtained in a state fit for analysis. As potassium sulphate is formed in the reaction it is evident that the tribromo-phenol must have undergone reduction, and may perhaps have become converted into a bromo-derivative of the so-called phenylen oxide, $C_{12}H_8O_2$.

The second communication was a "*Note on the Action of Nitric Acid on Tribromo-phenol.*" It is well known that nitric acid converts trichloro-phenol into dichloro-quinone, but the authors find that tribromo-phenol yields *para*-nitro-dibromo-phenol when acted upon with nitric acid. If more than 1 molecule of nitric acid be employed the nitro-dibromo-phenol is further converted into dinitro-bromo-phenol, and the latter alone is obtained if the phenol be added to an excess of the acid.

The PRESIDENT having thanked the authors in the name of the Society,

Mr. E. NEISON read a paper on "*The Sebates of the Alcohol Series*," in which, after referring to his published examination of the metallic sebates, he described the methods he had adopted in the preparation of the alcoholic sebates, and the properties of the resulting compounds. The methyl sebate was obtained by the action of sulphuric acid on a solution of sebacic acid in methylic alcohol. It crystallises in pearly needles and plates, which melt at 38° C., and boil at 287° C., but the substance is at the same time decomposed. The ethyl sebate, which closely resembles the methyl sebate, was prepared by passing

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hydrochloric acid into an alcoholic solution of the acid. It melts at 3·5° C., and boils at 307° C. Ethyl-hydrogen sebate is also formed in the preparation of ethyl sebate, but in comparatively small quantity. Amyl sebate, prepared in a manner similar to the ethyl salt, is an oily liquid boiling at about 366° C., and of specific gravity 951 at 18° C. The author has also prepared and examined hydrogen-amyl sebate.

The SECRETARY then read a communication from Mr. P. P. BEDSON "*On some Compounds of Ether with Anhydrous Metallic Chlorides.*" When ether is heated with vanadium oxychloride for two or three hours at 70° C. a compound is produced having the composition—

$$VCl_3C_4H_{10}O_2,$$

which may be obtained in long needle-shaped crystals, melting at 20° C. They are, however, very unstable, readily undergoing spontaneous decomposition. Ether acts violently on titanium tetrachloride, producing the compound $TiCl_4,C_4H_{10}O_2$. It forms a yellow crystalline mass, which melts at about 45° C., and boils at about 120° C. At the same time a compound, $TiCl_3(OC_2H_5)$, which the author calls titanic trichlorhydrin, is formed, especially if the mixture be quickly heated in an oil-bath. It melts at about 78°, and boils at about 188°.

The last paper was entitled "*Observations on Variations in the Composition of River Waters,*" by Mr. J. ANDREWS, and contains an account of the total solid matter and the loss by ignition of the waters of the Don, a Yorkshire stream, collected at different periods, both during dry seasons and at flood times.

The PRESIDENT, after thanking the author, announced that the meeting would be adjourned until January 20, when a paper "On Narcotine, Cotarnine, and Hydrocotarnine (Part IV.)," by Mr. G. H. Beckett and Dr. C. R. A. Wright, would be read.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, October 28th, 1875.

JOHN PATTINSON, President, in the Chair.

PRESIDENT'S ADDRESS.

(Concluded from p. 290.)

THE Weldon process of bleaching-powder making still continues to make great progress. Mr. Weldon tells me that, leaving out of account the 10,000 tons or so of bleaching-powder made by the Dunlop process in Glasgow, considerably over 90 per cent of the total bleaching-powder made in Great Britain is now made by his process. It is also being extensively adopted in the continental works. I frequently hear reports from persons using this process of the ease and regularity with which it is conducted. On the Tyne, Mr. Weldon says, a ton of bleaching-powder for about 55 cwts. of salt decomposed is obtained in more than one manufactory, whilst in Lancashire still better results have been found; for in one works the acid from little more than 50 cwts. suffices to yield a ton of bleaching-powder. No doubt the difference in yield found in different works depends in a great measure on the methods of condensation of acid adopted. I have Mr. Weldon's promise that he will endeavour to prepare a paper for this society this session on the methods of condensation followed respectively on the Tyne and in Lancashire, and also in France and Germany.

The manufacture of bleaching-powder by the Deacon process has diminished on the Tyne, only two works ollowing it at present. The conditions of continuous successful working have evidently not yet been discovered.

In the chemistry of the processes employed in that other important industry of our district, the treatment and manufacture of lead and its compounds, there is no much that is very new to record. Some attempts have been made to introduce a wet method of producing white-lead as a substitute for that produced by the old Dutch process, but hitherto, I believe, with but little success. Other processes with this end in view are in progress, of which we may hear something in the future. The principle of separating silver from lead discovered by that gifted and good man, the late Hugh Lee Pattinson, still remains the one on which the greater part of the lead is treated in this district—I mean that based on the fact that the crystals of lead which first form from a cooling mass of molten argentiferous lead contain much less silver than that portion which remains in a molten condition. The mode of applying this principle in practice, although still largely used in the manner suggested and carried out by Mr. Pattinson, has undergone many modifications and improvements. One of the most notable of these is now being adopted on a large scale by Messrs, Cookson and Co., at their works at Howdon, and is being used by Messrs. Walkers, Parker, and Walker, at their Elswick works, and by the London Lead Company at their works at Stanhope. The process is the invention of M. Rozan, and consists in passing a jet of high-pressure steam through the molten lead, and running on the surface a stream of cold water in order to promote the rapid formation of crystals. The pan in which this operation is performed is placed at such an elevation that the fluid portion of the lead can be run from the bottom when the required amount of crystals has been formed. The application of steam has also the important advantage that it oxidises the copper, antimony, and other impurities in the lead, so that the usual preliminary process of "improving" in a separate calcining furnace can be dispensed with in the treatment of pig lead containing an ordinary amount of these impurities. The amount of dross formed in the new steam process is only five-eighths of that made by the old process. Messrs. Cookson and Co. have supplied me with data from which I find that the cost of labour in producing a ton of market lead from hard silver-lead containing from 80 to 100 ozs. of silver per ton, is, by the old process, 17s.; by the new steam process, 3s. The amount of fuel, including that required for calcining, is 18 cwts. per ton in the old process; and 6 cwts. per ton, including that required for generating steam and working cranes, in the new process. On the other hand, the wear and tear of plant is much greater in the steam process; but this I understand is amply compensated for by the saving in working expenses. In Messrs. Cookson and Co.'s manufactory, where I have had the pleasure of seeing this process at work, there are the most admirable engineering arrangements for the saving of labour. The lead from its entrance into the works to its exit as market lead is only twice lifted by human hands.

Within the last few years Messrs. Lock, Blackett, and Co. have worked a modification of Parkes's process of desilverisation by means of zinc, which is said to be more economical than the Pattinson process. In this plan the lead is melted, without previous improving, in large iron pots, and about 1¼ per cent of its weight of zinc is added in three successive portions. After the addition of each portion, the mixture is well stirred for about half an hour. The fire is then damped down, and the contents of the pot allowed to cool. The zinc combined with most of the silver floats to the top, and when sufficiently solidified the crust of zinc and silver is removed. This is repeated after each addition of zinc. The desilverised lead is now run into an improving furnace, where it is heated until the small quantity of zinc remaining in the lead is oxidised and separated. The lead then is soft and ready for the market. The crusts of zinc and silver are heated in pots so as to separate some of the lead still remaining. The zinc and silver alloy is then heated in plumbago crucibles in order to distil off the zinc, and the residue of silver and lead is cupelled in the ordinary way to separate silver.

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The manufacture of acetic acid on a new plan has lately been commenced by the Tyne Acetic Acid Company at their works at Scotswood. The property of a solution of chloride of calcium and acetate of lime of forming crystals of the double salt is taken advantage of in order to get rid of tarry and other organic matters. The process is patented by Mr. Condy. A very fine quality of acetic acid is produced suitable for use in the manufacture of pickles, and for other purposes where a pure acetic acid is required.

The steam jet apparatus of Messrs. Körting Brothers is already extensively applied to various purposes in chemical works and other manufactories in England, as well as in America and on the Continent. This apparatus consists of a jet of high pressure steam applied somewhat like a Gifford's injector through a series of conical tubes for the purpose of moving or forcing gases and liquids in any required direction. It has been applied to force air through the gas-producers in connection with Siemens's furnaces and to the fires of ordinary steam boilers. For ventilating purposes it has been applied to workshops, mines, drying rooms, and other places. It has been somewhat extensively applied as an exhauster in gas-works to take off the pressure of gas in the retorts, and also for revivifying the oxide of iron used in purifying gas without removing it from the purifiers. Steps are now being taken to apply it to the carbonating and other furnaces of chemical works in this district. When applied to ordinary steam-boilers the apparatus is arranged so as to force air through the fire from below the grate. Several of these have already been fitted up in this neighbourhood, and, it is said, have been the means of effecting a considerable reduction in the amount of fuel used. Mr. Marshall, of the firm of Messrs. R. and W. Hawthorn, has furnished me with the following particulars, showing the amount of fuel used before and after the application of the Körting blowers in their engineering works at St. Peter's, near Newcastle. Before the Körting apparatus was applied, a Root's boiler and a Cornish boiler, consuming together in 230 hours of twenty consecutive days 78 tons 2 cwts. 2 qrs. of unscreened coal, were used to raise steam for the requirements of the works. With the Körting apparatus they find they can dispense with the Cornish boiler, and the same work was done in the same number of hours with 36 tons 7 cwts. 2 qrs. of a mixture of two-thirds of small coal and one-third unscreened. There is in this case a saving of upwards of 50 per cent of fuel. At a Cornish boiler in their works at Newcastle the economy is not so marked, but it is still considerable. For doing the same amount of work for twenty consecutive days of 12 hours each, there were required per day:—With natural draught, 96 cwts. of unscreened coal at 12s. 6d. per ton; with the Körting blower, 90 cwts. 2 qrs. 10 lbs. of small coal at 7s. per ton; thus showing a saving of about 28s. per day. The reasons why this economy of fuel can be effected with this apparatus appear to be the following:—1st. The intensity of combustion is very great, owing to the air being brought under pressure into contact with the fuel. The proportion of heat utilised under these circumstances is greater than it is with a slower combustion. 2nd. The combustion is quite independent of chimney draught, so that the heat required for producing chimney draught can be used for raising steam. 3rd. The fuel, even if of an inferior description, is burnt completely away, so that none is thrown away with the ashes. I deem this invention worthy of the attention of all our members engaged in manufacturing operations.

Spectrum analysis has been one of the most important discoveries of our time and one most fruitful in its results. By its means not only have we been able to learn the constituents of the sun and the most distant stellar bodies, but the existence of several new elements has been revealed to us through its agency. So lately as two months ago the announcement comes of the discovery of another element by its means, which its discoverer, M. de Boisbaudran, proposes to call "Gallium." It was found in an ore of zinc, and appears to have chemical characters similar to the latter metal. Sundry attempts have been made by Mr. Norman Lockyer and Mr. Chandler Roberts to make spectrum analysis available for obtaining quantitative results, and a certain measure of success has been arrived at by these gentlemen in examining alloys of the precious metals, but scarcely sufficient to warrant them in recommending its adoption in the place or other known methods of analysis. Sir John Alleyne, of the Butterley Iron Works, has more recently announced a method of applying spectrum analysis to the determination of small quantities of phosphorus in iron and steel. Sir John read a paper on the subject before the Iron and Steel Institute, and showed the apparatus in action at the meeting of this body in May last. He discovered that the lines of the spectrum indicating phosphorus are blotted out or rendered invisible in an atmosphere of hydrogen gas, and the amount of oxygen gas (which he introduces in the form of carbonic acid) required to make these lines visible, forms a measure of the amount of phosphorus in the iron or steel under examination. The process, so far as I am aware, has not yet been carried into practical use in any steel works, but it suggests a most promising field for future research.

Although, as I have said at the commencement of this address, the work of the last session has been equal in amount to most of its predecessors, it must not be thought that there is no scope for improvement in this respect in the future. It cannot be urged that there is any dearth of subjects suitable to be dealt with. Almost any one of the processes I have alluded to this evening would form an excellent subject for a paper. Let me, in conclusion, then ask that a larger number of our members will undertake the preparation of papers in the session now commencing in order that the time spent at our meetings may be fully and usefully occupied, and the prosperity of our society not only maintained but increased.

Mr. Glover, in moving a vote of thanks to the president, endorsed all that had been said with regard to the "soda-test." As to the modified balling process, he doubted the advantage of introducing caustic lime. Speaking of the spontaneous combustion of coal, he said, in his evidence before the Commission, he had pointed out that the mere presence of pyrites in coal was of less consequence than the state of division in which it existed. As to the pollution of rivers, they ought to be careful how they interpreted the term. He was of opinion that some rivers might be manured with as much advantage as fields. The sewage fed infusoria, and infusoria fed fish which fed us. Within certain limits, then, the addition of organic matters to a river might be actually useful.

Mr. Berkeley seconded the vote of thanks, which was carried by acclamation.

The President, in returning thanks, said the members would best thank him by themselves contributing papers on the subjects which came within the scope of their daily work.

NOTICES OF BOOKS.

Dyeing and Calico-Printing, including an Account of the Most Recent Improvements in the Manufacture and Use of Aniline Colours. By the late Dr. F. Crace-Calvert, F.R.S., &c. Edited by J. Stenhouse, LL.D., F.R.S., &c., and C. E. Groves, F.C.S. Manchester: Palmer and Howe. London: Simpkin and Marshall.

In no department of industrial science is there so much room for new works as in connection with the arts of dyeing and calico-printing. So wide is the subject, so rapid are its advances, and so difficult—or rather impossible—it is for any one man to become acquainted with

everything of value which it presents, that a competent and conscientious author is sure to lay before his readers much which is both novel and useful. It is therefore with sincere pleasure that we welcome this posthumous production of the late lamented Dr. Calvert—a man who has passed away from our midst too soon for science. As the latest fruit of his mind, it derives for all who had the pleasure of his acquaintance an additional interest.

The work before us does not profess to enter into all the technical details of the tinctorial arts. Into the plant and machinery of the dye-house, the printing-shop, and the colour-factory it enters but slightly. Nor does the preparation of the various compounds of alumina, iron, tin, and chrome used as mordants, or the preparation and application of the mineral colours, come within the author's plan. After treating of colours in general—their cause, nature, behaviour with light, heat, electricity, bleaching-agents, &c.—he reviews madder, with its various natural constituents, commercial preparations and uses, and its modern substitutes—artificial alizarin and anthrapurpurin. He next passes to the red dye-woods, safflower and alkanet; indigo, with the new process of Schützenberger and de Lalande; cochineal, lac and murexide; orchil and its connections, including the new and charming colour eosin; quercitron, fustic, Persian berries, and other natural yellow and orange dyes; tannin, its sources and products, among which figure gallein and cœrulein. Next follows a section on the examination of colouring-matters and coloured fabrics. The remaining chapters are devoted to the manufacture and uses of the aniline, phenol, cresol, and naphthalene colours, and give—if not all practical details—a correct and comprehensive view of the latest improvements in this region of tinctorial chemistry. An appendix gives a series of very useful tables for distinguishing the different colouring matters as fixed on tissues by dyeing or printing.

Among the numerous patterns of dyed and printed tissues, with which the work is illustrated, a particular interest attaches to those of eosin, gallein, cœrulein, French purple, and garancin with an uranium mordant—the latter a novel and pleasing effect.

The work, it must be distinctly understood, is not mainly, or professedly, a collection of receipts and formulæ—though these are by no means wanting. But the thoughtful dyer or printer will find it full of suggestions, which in good hands will prove much more valuable than mere receipts. As a specimen of these hints we extract the following passage:—"If dyers, instead of using catechu as imported, were to grind it and wash with cold water, they would obtain an extract which would yield very pure shades of green-drabs, whilst the insoluble residue of catechin would give a great variety of tints." Is it too much to say that in these few lines the germs of many practical receipts are lying dormant?

We do not, of course, maintain that the work is in all respects faultless. There are passages which may possibly be considered needless digressions, such as the account of kermes, and the notice of the occurrence of indigo in human urine. Possibly the space thus filled might have been more usefully occupied. The process given for the preparation of archil is not by any means the most improved in existence. But, in spite of these and certain other occasional blemishes, every candid reader, capable of judging, must pronounce this book a most valuable addition to our technological literature. No dyer, calico-printer, colour manufacturer, or student of tinctorial chemistry can consider his library complete without it.

The author's literary executors, Dr. Stenhouse and Mr. Groves, have been well selected, and have faithfully performed their task. We must, in conclusion, express our confident hope that this work will subserve that end for which its author laboured with such skill and perseverance—the promotion of a more truly scientific spirit among our dyers, and printers, and colour-makers, and, in consequence, of a new impulse to English tinctorial art.

CORRESPONDENCE.

"PREVENTION BETTER THAN CURE." FOOT-AND-MOUTH AND OTHER CONTAGIOUS DISEASES AMONGST ANIMALS.

THE following letter, addressed to His Grace the Duke of Richmond, Lord President of the Privy Council, has been forwarded to us for publication:—

To HIS GRACE THE DUKE OF RICHMOND.

MY LORD DUKE,—In common with the public generally I have read with much interest and satisfaction your remarks on the prevailing cattle-diseases and the measures adopted for their repression. The present system of eradicating such disease, by the destruction of the animal affected, I cannot help thinking is not in harmony with the dictates of Science or sound reasoning. If it is true that "Prevention is better than Cure," and that "Cleanliness is Godliness," then it would seem the principle of "stamping out" is an inconvenient, wasteful, and extravagant process, and that our efforts should be more directed to disinfection and promoting comfort and cleanliness amongst cattle in transit, whether by rail or by sea.

The promotion of comfort and cleanliness amongst animals is a matter that requires no definition, but the question of disinfection is a matter that must be subject to the laws and experience of Science. The public mind is at this moment somewhat puzzled by confounding the terms "disinfectants" and "deodorants" with each other, whereas I believe their functions are quite distinct; the object of the one is to destroy those invisible organic germs which constitute contagious matter, whilst the other is simply by chemical action to decompose or alter the character of a gas, and at the same time change its natural odour or smell: the latter action is explainable by the merest tyro in chemistry, whilst the action of disinfectants is past explanation; all that can be said is that experience teaches that they do destroy or kill the contagious organism. If, then, this definition of disinfectants and deodorants is acceptable as true, it follows that in the matter of contagious disease—whether of man or animals—the two things must not be confounded, and that, however agreeable it may be to be rid of unpleasant smells by the action of oxidising or deodorising agents, we are in no degree by their employment defending ourselves against the deadly attack of the germs of contagion: one is the business of a perfumer,—or, more properly, anti-perfumer,—whilst the other is a "battle of life:" it is a test of what Darwin would call the power of the fittest to survive. Who shall say that epidemics and contagion, after all, are only vital storms to blow away feebleness, that health and vigour may have a better and larger field for existence and development. The natural tendency of feebleness without protection is to succumb to disease, and create consequent contagion, whilst the more powerful forces of health and energy act as an invincible armour of defence. How often in the vegetable kingdom, especially observable in agriculture, do we accuse the myriads of insect-life of destroying the plant, when in reality the diseased vegetable is the origin of its own army of scavengers! When our turnip and other crops are eaten up by mildew or green fly, may not the originating cause be a dry and unfavourable season? But from whence do these millions upon millions of germs of insect-life come, if not from the atmosphere, thus showing what powerful—yet invisible and destructive—agents the air we breathe may at all times carry, ready, like the "Constantinople dog," to eat up decay, test the fitness of life, and too often impregnate with the contagion of foot-and-mouth, rinder-pest, typhus, small-pox, and other terrible forms of disease and corruption?

It is, then, to wholesome food, ventilation, and *comfort* amongst animals, during transit from place to place, added

to cleanliness and disinfection, that we must look for protection against the diseases that human and other flesh is heir to; and until these common laws of Nature are truly and duly obeyed, we must expect to pay the various penalties imposed by negligence and disobedience.

What would be said of the discipline and management of those splendid forms of charity, our Hospitals, Infirmaries, &c., if the beds occupied by patients affected with contagious fevers were never cleansed, disinfected, or removed, but were used for fresh-coming patients with impunity, saturated as they would be with contagious matter? Again, what are we to say of railway, ship, and steam-boat management under similar circumstances? Is it to be expected that healthy cattle are to be crowded and stoved in railway trucks, the holds and decks of ships, that have only a few hours before been tenanted by a mass of diseased animals, and not escape contagion, and thus hand it on to other cargoes, and so on until the whole country becomes infected? These are chief amongst the propagating sources of foot-and-mouth and other contagious diseases, yet how simple and little costly is the *best* remedy: to cleanse is a mere matter of labour, and to disinfect is only a matter of syringing with a common garden-engine, and with a fluid that would not cost more than a penny per truck for railways, and for the holds and decks of ships probably ten shillings or a pound per voyage. Such disinfectants are supplied by Science, and may be had in any quantity and at the cost I have named: they are mostly constituted of the active principles obtained from products known in Science as "tars." It is true they have this peculiar yet healthy odour, but such is their nature, and it is probable to this may be attributed in some degree their valuable effect; to change this or to deodorise them would be to destroy their intrinsic character altogether.

My Lord, in conclusion I beg to apologise for constituting myself one of a host that daily attack our Government officers with advice gratis or not, as the case may be, and against whose attacks a disinfectant is probably required even more than for our mute and suffering animals,—beast, sheep, &c.,—but I have had bitter and costly experience from foot-and-mouth pleuropneumonia and rinderpest, and shall be only too glad if I can in any way promote the adoption of the best and most permanent remedy, as I am a firm believer that in all cases of disease "Prevention is better than Cure."—I am, &c.,

W. LITTLE.

The Hall, Heckington, Lincolnshire.

LIVERPOOL SODA-TESTS.

To the Editor of the Chemical News.

SIR,—The following circumstances may be, perhaps, of interest to some of your readers as bearing on the high percentage of soda in soda-ash, &c., reported by certain Liverpool trade analysts. During the years 1866 and 1867, I acted as "chemist" to a large alkali works, the majority of the produce of which was tested in Liverpool. My own analyses were uniformly made on the supposition that anhydrous carbonate of sodium contains 58·5 per cent of oxide of sodium (Na=23); that is, the test-acid was so graduated that 100 parts of pure carbonate of sodium neutralised 58·5 volumes of acid. In order to make my results square with those of the Liverpool testers, it was the custom to add from 1¼ to 1⅝ to the percentage found by me, and invoice the substance according to their higher value. For instance, if I found 46⅝ per cent, the ash was called 48; if I found 48¼, it was called 50, and so on.

I have letters in my possession which prove that this kind of practice had been in use for years previously; whilst from enquiries I have subsequently made, I am let to believe that the system is still in use, and that in more works than one.

In many works, it is usual to graduate the test-acid on the supposition that anhydrous carbonate of sodium contains 59·25 per cent of oxide of sodium; that is, 100 parts of carbonate are neutralised by 59¼ volumes of acid, the percentage of oxide of sodium in carbonate of sodium being 59¼, if Na be assumed=24. The result of this graduation is that alkalimetric tests made with such acid are ¾ of a per cent out of 59¼ too high; that is, about one-half of a per cent on a 48 soda-ash. Hence, even on the assumption that Na=24, the increased value allowed by trade custom (applicable in certain districts only) is *something like 1 per cent out of 48 less than that found by the Liverpool analysts*; or, in other words, the consumer is made to pay for 100 parts of material when he gets less than 98 even in accordance with this trade custom, and whilst actually only about 97 parts are really present.

In former letters to the CHEMICAL NEWS, I have not hesitated to express my opinion on the morality of such proceedings (vol. xvi., 170 and 196), and I have as yet seen no reason for changing my views.—I am, &c.,

CHARLES R. ALDER WRIGHT, D.Sc.

Chemical Laboratory,
St. Mary's Hospital, Paddington.
December 20, 1875.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 21, November 22, 1875.

Thermic Researches on Citric Acid.—MM. Berthelot and Louguinine.—The authors conclude that 1 molecule of citric acid dissolved, $C_{12}H_8O_{14}=192$ grms., disengages in presence of 3 equivalents of soda (NaO=31 grms.) an amount of heat almost triple that which 1 molecule of acetic acid would evolve. This is a characteristic property of the tribasic acids, of which 1 molecule is equivalent to 3 monobasic molecules. The three equivalents of soda successively added disengage amounts of heat nearly alike, which signifies that the formation of acid citrates by means of a tribasic citrate and free acid only brings very small quantities of heat into play. The same thing occurs with the acid oxalates, tartrates, acetates, and valerianates, but in these two latter salts the resulting phenomenon is a liberation of heat; whilst in the oxalates, tartrates, and citrates there is a slight absorption. In presence of a suitable quantity of water, the heat disengaged is not notably increased by the presence of an excess of base greater than three equivalents; but the heat varies very sensibly, on the other hand, if this excess of base is employed in more concentrated solutions. This is a result foreseen by theory, for citric acid is a body of mixed function—tribasic acid, and mono-atomic alcohol, $C_{12}H_6(H_2O_2)(O_4)_3$. By reason of the stability of tribasic alkaline citrates, citric acid may be titrated in a closely approximate manner by employing baryta and litmus (*Ann. de Chim. et Phys.*, t. lxv., p. 402). The authors examine, further, the behaviour of water with citrates, of citric acid with ammonia, baryta, and with two successive bases; and the action of acids upon citrates.

Remarks on the Interpretation of Two Tables of Chemical Analyses.—M. P. Duchartre.—An examination of the views of M. Violette on the defoliation of the beet-plant, as laid before the session of October 4. The author holds that, under conditions strictly comparable, defoliation reduces the yield of the beet, per hectare, by about one-half, and the net produce of sugar by more than one-third. He announces his intention of showing that this double result is the natural consequence of physiological data.

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Electrolysis of Bodies of the Aromatic Series.—M. Goppelsroeder.—The author has been occupied with this subject since the end of the last year. The paper of M. Coquillion concerning the direct formation of an aniline-black by the electrolysis of two salts of aniline has induced him to communicate his results. He has observed the formation of an aniline-black obtained directly by the oxidation of aniline by means of electrolytic oxygen. It possesses a metallic lustre like the aniline colours in general, and gives a complete black colouration upon paper. He has turned his attention to the most different groups of the aromatic series, and has discoursed before the Committee of the Industria' Society of Mulhouse on the difficulties presented by the electrolysis of organic bodies, and on the precautions to be taken. He mentions the influence of temperature, of the concentration of the liquid, of the pressure under which electrolysis takes place, and points out the importance of a thorough investigation, the simultaneous employment of electrolysis and dialysis, and on galvanic decomposition in closed vessels under high pressure. Electrolysis does not always give the same results as decomposition by chemical agencies. Instead of employing the electrolytes in a state of isolation, they may be mixed with other bodies, so that in consequence of electrolytic decomposition the radicals of the bodies may act upon each other. He is convinced that electrolysis will yet be employed in dyeing and printing.

Fixation of Atmospheric Nitrogen in Soils.—M. P. Truchot.—The author holds that the proportion of nitrogen in soils is in a direct relation with the quantity of carbon contained in such soils in the form of ulmic compounds, and there is reason to believe with Dehérain that the nitrogen of the atmosphere becomes fixed upon these carbonaceous compounds before concurring in the nutrition of plants.

Water of the Vanne, and Distilled Waters.—M. E. Monier.—The water of this stream, when hot, decomposes only 0·5 to 0·6 milligramme of permanganate per litre.

Construction of Lightning Conductors.—M. E. Saint-Edme.—The author rejects copper and platinum for the points of lightning-rods, and prefers iron coated with nickel.

Formation, Structure, and Decomposition of the Swellings on the Vine caused by the Phylloxera.—M. Max Cornu.—Not adapted for abstraction.

Reactions of the Homologues of Ethylen, which may Explain their Absence in Natural Petroleums.—M. J. A. le Bel.—The products of the reaction of water upon the olefines are almost entirely soluble in water; the higher homologues of the series, co mencing with heptylen, yield crystals which deposit in the aqueous stratum, and even in the oil. These bodies are easily destroyed by heat; their decomposition, if once begun, continues spontaneously, and if large quantities are used a formidable explosion results. As the petroleums of America are always found accompanied by a large quantity of water, we may admit that the alterable and non-saturated carbides have been eliminated, and that their products of decomposition have been carried off by the circulation of underground waters, whilst the resins and the saturated hydrocarbons have remained and formed the oils as met with in its natural state.

Remarks in Connection with the Discovery of Gallium.—M. D. Mendeleef.—See page 293.

True Mineralogical and Chemical Place of Troilite.—M. J. Lawrence Smith.—The author finds the composition of carefully chosen specimens to be—

Iron	63·80
Sulphur	36·28

The specific gravity is 4·813. He considers that troilite, like its companion, schreibersite, is exclusively of meteoric origin.

Defoliation of Beet-Root.—M. Ch. Violette.—A reply to a paper by M. Cl. Bernand (*Comptes Rendus*, tome lxxxi., page 698).

Certain Alterations in Agates and Flints.—M. C. Friedel.—Certain agates from Corrientes (Uruguay) were found chiefly transformed into an earthy mass, perfectly white, sectile, and friable. The author ascribes this change to a partial solution of the more soluble portions of the specimens.

Explosive Compounds: Influence of the Primer on Compressed Gun-Cotton.—MM. P. Champion and Pellet.—The authors object to the English primers, and propose a modification.

MISCELLANEOUS.

South London School of Pharmacy.—The Annual Dinner of the students of this school was held on the 17th inst., at the Horns Assembly Rooms, Kennington. There were 100 students present, besides several gentlemen connected with the institution, and a few visitors, among whom we noticed Messrs. Tyndall, Brown, Ince, Wooton, and Cornish. Dr. Muter, as usual, presided, and gave the toast of the evening—viz., "Success to the S. L. School of Pharmacy," which was heartily responded to, while the tumultuous cheers which greeted the proposal of Dr. Muter's own health by Mr. Barker, of Clifton (an old student), proved his great popularity with his students. During the evening the following medals and certificates of merit were presented:—*Senior Chemistry*—medal, Mr. Hannah; certificate, Mr. Bumpstead. *Junior Chemistry*—medal, Mr. Shepley; certificate, Mr. Brooks. *Botany*—medal, Mr. Hunter and Mr. Kerr; certificates, Mr. Bumpstead and Mr. Fryer, equal. *Materia Medica*—medal, Mr. Kerr; certificate, Mr. Hannah. *Pharmacy*—medal, Mr. Brooks; certificate, Mr. Shepley.

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THE CHEMICAL NEWS.

Vol. XXXII. No. 840.

A NEW PHASE OF ELECTRIC FORCE.

While engaged in electrical experiments, Mr. T. E. Edison, of Newark, U.S., who was one of the first inventors of the quadruplex system of telegraphy, noticed that the accidental contact of a wire with the core of the magnet caused the production of a bright spark when a metallic substance was applied to it. These sparks have frequently been noticed by electricians, but Mr. Edison is the first to enquire into their cause and effects. His investigations have led him to conclude that he has thus discovered a new force to which he has given the name of "Etheric Force." Its nature may, perhaps, best be explained by comparing it with heat, for like heat, it seems to radiate, but with much greater velocity and to a far greater extent. It passes readily into the human body and also into glass, but apparently prefers metals to other substances. It gives no evidence of polarity, which is so closely identified with all electrical phenomena.

We learn from our friend Dr. G. M. Beard, who has submitted the supposed new force to physiological tests, that it can be obtained from any self-vibrating electro-magnet, or from an electro-magnet operated on by an ordinary Morse key. All that is necessary is to connect a wire to the core of the magnet or any metal in connection with it; or it may be generated by a piece of cadmium or a copper rod surrounded by a helix of wire, placed in a battery circuit, and interrupted by a key. Cadmium is found to answer better than any other metal. Sparks are obtained by the edge of a knife or the end of a lead pencil drawn lightly along the wire or conductor. The spark is the only evidence we have of the existence of this force, there being, at present, no other known phenomenon by which it can be detached or measured. It is supposed that electric force, acting on the apparatus above described, is transformed into this new force, which in turn is transformed into light, and thus we are enabled to detect its presence.

The following mode of producing the sparks is given in the New York *Journal of the Telegraph*:—"Upon an insulated table place an ordinary Morse key and an electro-magnet, the coils of which are so wound that no magnetism is produced in its cores by the passage of an electric current. Use for an armature a piece of the metal cadmium, to one end of which fasten a flat spring. The other end of the spring attach rigidly to a standard fixed on the table. Adjust the armature a short distance away from the core of the magnet. The standard is to be connected by wire to one end of a glass rod or tube, say 2 feet long. The other end of the tube connect by wire with a graphite point (a lead pencil will answer). Another graphite point is connected by wire to a gas-pipe or other suitable mass of metal, not in contact with the apparatus, and the two points, in position similar to the arrangement for producing the electric light, may be placed in a box from which light is excluded, but with a hole in the top for observation. Place 10 or 15 Bunsen cells in circuit with the key and the coils in the usual manner. Now, if the key be closed, a spark of considerable brilliancy will be evolved from the graphite points, but possessing no continuity. If, however (the battery circuit remaining closed), any part of the connection between the gas-pipe and the cadmium is broken, and contacts be made either slowly or rapidly between the disconnected points, the spark reappears at each contact."

Many experiments have already been made by Mr. Edison and Dr. Beard. The following is a description of one of them in Dr. Beard's own words:—"I stuck a penknife in a large block of paraffin, and connected it with the battery, drawing the wire up and down the blade. No sparks appeared. When a long file was substituted for the knife, sparks were abundant, and were kept up as long as the connection was made. Where, then, did the power go to? Into the air? or the earth? I suspended then by silk rolls of wire of various sizes, and allowed them to strike against the connection. With small coils sparks rarely appeared; with the larger coils they were abundant. It would seem, therefore, that a certain size is necessary in the conductor in order to get the sparks. At one time we led the wire through a large vessel filled with water, and pieces of iron and bars of iron of various sizes were placed across its track and resting upon the wire, and the wire was wound round an iron press, and yet at the end the spark appeared. Mr. Edison took the wire out of doors, ran it along the ground and in a ditch on a rainy night, and brought it up stairs several rods from the battery, and the spark was seen by him, by his assistant, and by myself in a dark box; but it was not constant, and required a nice adjustment of the carbon points to bring it out."

The evidences that the force indicated by the sparks coming from the apparatus above described is a new form of electricity not generally recognised, are:—

First. It gives no evidence of polarity, and cannot by known laws of electricity complete a circuit, and it does not decompose iodide of potassium, a test, as all electricians know, of exceeding delicacy. Mr. Edison says that he passed the force through iodised paper for three hours, and no effect was produced.

Second. It has no demonstrable physiological effects. Electricity of any form, giving such a spark as this, would be felt on the tip of the tongue if touched lightly, even if no other physiological effects were appreciated. A current from 2500 very small water cells is of such small quantity and high potential that it is little if at all felt on the tongue, as Prof. J. E. Smith tells us, but such a current would at once respond to other tests of electricity.

Third. It will pass through insulators better than electricity. A dry hollow glass tube, half an inch in diameter and 2 feet long, does not prevent the passage of the force, showing that it is not easily insulated. The spark weakens, however, after the force has passed through the rod, just as after it has passed through the body. In these tests the spark is studied at the point of contact of the sharpened ends of lead pencils enclosed in a dark box with a small hole in the top.

Fourth. It does not charge a Leyden jar nor deflect the needle of Thomson's mirror galvanometer. Mr. Edison tested these instruments by the force many times, and has performed the experiments in Dr. Beard's presence.

Fifth. The spark that comes from it resembles in appearance the spark that comes from dynamic electricity, and not the spark of inductive electricity, in a state of high potential. It scintillates, and does not jump through the air, but requires actual contact, and in that respect differs from the spark of inductive electricity. If it were inductive electricity at high potential it would jump through the air.

In a letter dated December 11th, Dr. Beard promises to send us more details in a few days. We hope, therefore, to give in an early number the results of further experiments together with an illustrated description of the apparatus employed by Mr. Edison. His investigation will probably lead to great practical results. Our thanks are certainly due to him for having opened a new field for scientific research.

THE NATURE AND LAWS OF CHEMICAL ACTION.

By E. VOGEL, San Francisco.

It is a well established fact of organic chemistry that when 2 or more molecules of carbon (C = 12) unite to form one co. molecule, the equivalence of the compound is less than the sum of the equivalences of the single molecules, $C=4H$, $C_2=6H$, $C_3=8H$ . . . $C_n=2n+2H$, instead of $C_n=4nH$.

If 2 molecules of fluorine (Fl = 19) combine in the same manner,—

$$\begin{array}{l} 1=19-1 \\ 1=19-1 \\ \hline 2=38-2 \end{array}$$

the compound 1 = 36 is very near that of chlorine (Cl = 35·5). If 2 molecules of Cl combine with 1 Fl, the loss of equivalence being 4 for each Cl, and one on each side for the Fl molecule—

$$\begin{array}{ll} 1=35{\cdot}5-4 & 1=63-1 \\ 1=35{\cdot}5-4 & 1=19-1 \\ \hline 2=71{\cdot}0-8 & 2=82-2 \end{array}$$

the result is 1 bromine molecule, Br = 80. 2 molecules of 1 = 63 combining with 1 Fl, the loss of equivalence being proportional to the numbers—

$$\begin{array}{ll} 1= 63- 8 & 1=110-1 \\ 1= 63- 8 & 1= 19-1 \\ \hline 2=126-16 & 2=129-2 \end{array}$$

the iodine molecule is obtained, I = 127.

Considering the great chemical resemblance of the members of this natural group of elements, the evidence of their being compounds of fluorine is almost conclusive.

The discovery of these numerical relations is, however, not a result of accident. Their existence has been derived from conclusions based on the fact of a close connection between the spectral lines of the solar metals and their atomic weights. The main features of this connection are*—(1) That the distances of the H lines of the solar spectrum follow each other at the rate of squares: (2) that the lines of shortest waves of the solar metals express very nearly their atomic weights. On the foundation of these facts I have arrived at the conclusion that the H molecules, and consequently molecules generally, are composed of numerous atomic but exclusively ponderable constituents, in each case grouped around a common centre, and held together by no other force than that of gravitation.

By accepting this view of the inner constitution of matter, the following constant relations between distance, force, mass, and density are established as necessary consequences of the universal law of gravitation :—

(1.) Attraction decreases in proportion to the increase of the squares of distances, and consequently increases at the rate of the squares of approximation, reaching a maximum when the approximation is complete. Force and distance are inversely proportional. The sum of the distances at which the constituents of a body maintain each other by mutual attraction is its volume. The general measure of the attractive force is the weight of volume. If vol. = v, weight = p, their constant relation is—

$$v=p^2\,;\ p=\mathrm{V}v.$$

(2.) Extreme divisibility is the consequence of the atomic composition of matter. The maximum of force coinciding with the minimum of space, mass and force are inversely proportional; consequently weight, as a measure of force, increases with the decrease of mass.

(3.) Density expresses the relation of the number of constituents to their volume. It increases with the decrease of volume, and is a maximum = 1, when vol. a minimum = 1. Volume increasing with mass, density and mass are inversely proportional.

(4.) Density and number of constituent particles are directly proportional, v = vol.; m = mass; d = density—

$$v=m^2\,;\ m=\mathrm{V}v\,;\ d=\frac{m}{v}=\frac{m}{m^2}=\frac{1}{m}.$$

If chemical affinity and gravitation are identical forces, the laws of chemical action are determined by these relations.

The subject of chemical action involves the consideration of the nature of the expansive energy of gases.

The hypothesis of an imponderable ether, whose atoms repel each other and are connected with the movements of ponderable atoms, seems wholly inadmissible. Two atoms, in order to attract each other, must have firm supports—a capacity for offering resistance or overcoming the resistance of an opposing force. Without the power of resistance no display of force seems imaginable. Both attraction and repulsion pre-suppose the presence and contest of two forces, one tending to unite, the other to hold apart two distinct objects, attraction or repulsion ensuing as one force predominates over the other. Imponderable atoms can offer no resistance, and therefore neither attract nor repel each other; much less can they ever exercise any influence on ponderable particles.

Gravitation being common to all matter, gas molecules must attract each other with a force directly proportional to the diminution of their individual mass. The molecules of a gas being all exactly alike, the mutuality of their attraction will prevent the formation of larger compounds. The smallest nucleus that may have formed will attract other molecules from all sides; their forces combining as they approach, outweigh largely those of the nucleus; and the inner condition of gases must be that of a most lively contest among all the molecules, in incessantly approaching and receding from each other—a condition which has long been disclosed from the physical properties of gases; and the velocities of molecules have been found to be extraordinary; those of the H molecules, for instance, at the temperature of the freezing-point, seventeen miles per minute.

The knowledge of the identity of gravitation and expansive force of gases affords an insight into the cause of the gaseous state. Attraction cannot be otherwise than the result of an inequality of forces, and, between identical molecules, is possible only in consequence of a disturbance of the equilibrium of the molecular forces, which supposes a partial displacement of the molecular constituents.

The composition of molecules is either, more or less, simple or compound; atoms unite to form molecules of the first order; aggregates of these combine to larger molecules: molecules of different substances unite to form the molecule of a new substance, and so on. The attractive force being most intense in the molecules of smallest mass, a displacement of their component particles is proportionately difficult, and the gaseous state, therefore, the more perfect the lighter the weight of volume, the volume of gases being thus directly proportional to the smallness and density of their molecules.

In compound molecules the attractive force decreases with the distance from the centre. When by increase of temperature the velocities of co. gas molecules, and the force with which, in colliding, they strike each other, are considerably increased, the effect of the impetus may prove stronger than the force which binds the outer molecular layers; their constituents will then be forced from their natural positions, and, while scattering more or less in radial directions, be exposed to appropriation by neighbouring molecules just happening to strike them. The union of identical molecules is thus accomplished.

Aggregation, liquefaction, and solidification are conse-

* See particulars in *Scientific American* of Nov. 27, "Relation between Spectral Lines and Atomic Weights.

quently the effect of mass; and the gaseous state, the resistance to condensation, decomposition, and fusion, are indications of great density. These being the characteristics of all elementary substances, some idea can be formed of their origin or the conditions of their formation. The density of their molecules resisting the action of all known terrestrial agents, the constituents must have existed far removed from the general effect of the gravitation of the planetary mass, either as gases in high altitudes of the atmosphere, or must have originated on other heavenly bodies of much smaller mass.

The effect of the velocities of molecules represents the sum of the attractive forces contained in a given volume of gas, and is its expansive energy.

Molecular density or elasticity is directly proportional to the gas volume, and so is density to the number of molecules; the relation between number of molecules and volume is, therefore, not a constant one, but changes as $\frac{1}{m}$; and the law of Avogadro—"equal volumes of gases contain equal numbers of molecules"—is incorrect. This law, although the corner-stone of modern chemistry, has never been firmly established, but found at variance with important physical and chemical facts. Its fallacy is proven by the relation which has been established, by the mechanical theory of gases, to exist between volume and specific gravity, to the effect that the velocities of gas molecules are inversely proportional to the square roots of the weights of volume, which is the same relation $= \frac{1}{m}$, deduced by me from the general law of gravitation. As already shown, the value of the square roots increases with the decrease of volume; and it is evident that the velocity of gas molecules is equivalent to their elasticity, and this to the volume.

The discrepancies of Avogadro's law are due to the same causes as those of Mariotte's—to condensation, dissociation, or decomposition. All these changes are the result of compression, for increase of temperature at constant volume is but another mode of compression, and the pressure of a surrounding colder medium produces in all cases of increase of temperature an effect more or less approaching to constancy of volume. The result of condensation or decomposition depends on the quantity of the individual molecular mass. The exceptional behaviour of H, increasing in volume under great pressure, while that of all other gases, under the same circumstances, decreases, can only be accounted for by disintegration or dissociation of the H molecules, all other gases undergoing partial condensation.

The extent of the disintegration of gaseous aggregates is illustrated by the vapour of sulphur, 1 volume of which weighs—

At a temperature of	500° 96 = 3,	density = 0·58.
,, ,,	600° 72 = 2¼,	,, = 0·67.
,, ,,	700° 40 = 1¼,	,, = 0·91.
,, ,,	860° 32 = 1,	,, = 1·00.

The density of the volume weighing 32, consequently the number of molecules contained in it is $\frac{1{\cdot}00}{0{\cdot}58}$, or nearly twice the number contained in the volume weighing 96.

Condensation by increase of temperature seems well illustrated by the occurrence of frequent showers in a warm, moist atmosphere. Solar radiation must, of necessity, constantly reduce water vapour to a more gaseous state. The greater tension of this gas will finally either overcome the resistance of the surrounding more ponderous masses of vapour, or these breaking in upon and mixing with it, condensation is effected by means of the greater density of the finer constituents. The liberation of heat attending condensation adds to the effect of new insolation, and the frequency of the phenomenon is the result.

The law of Avogadro, as also that of Boyle or Mariotte holds good for identical substances as long as there is no change in the nature or state of the latter; and if expansive energy of gases, gravitation of matter, and chemical affinity are identical forces, the chemical union of identical substances must take place in conformity to Mariotte's law, while that of different substances is the function of density.

The co. molecules of C and Fl are examples of identical masses chemically united. The attractive force has, in these cases, the same effect as mechanical compression; its amount being that of 1 molecule, and the effect at each increase of 1 a reduction of volume amounting to one-half of a molecular volume. The relations between increase of mass and volume are consequently—

$C = 4H.$
$C_2 = 4+\frac{1}{2} = 6H.$
$C_3 = 6+\frac{1}{2} = 8H.$
$C_4 = 8+\frac{1}{2} = 10H.$
$C_5 = 10+\frac{1}{2} = 12H.$

To the number of molecules 2, 3, 4, 5 corresponds a diminution of the increase of volume at the rate of $\frac{1}{1}, \frac{1}{2}, \frac{1}{4}, \frac{1}{8}$, which is the simple relation of Mariotte's law.

In the compound C_3 2 molecules bind a third, and the total reduction of volume is $3\times4 = 12-8 = 4$. If the attractive force were doubled, and that of 2 molecules, the reduction of volume would be $2\times4 = 8$, and this is the rate of loss of equivalence when 2Cl combine. In the molecule C_5 4 molecules bind one in addition, the reduction of volume being $20-12 = 8$. It would be $2\times8 = 16$ if the attractive force were doubled, which is the case in the compound of $I = 63$, forming the base of the I molecule.

That density is the active principle of chemical affinity, and that the gaseous elements and Br and I, their compounds, also C, are the densest bodies, is proven by the general fact that they combine with all other elements. The remarkable multiplicity of properties exhibited by organic bodies composed of the densest element finds thus a natural ground of explanation. H being the densest, and heading the list of elementary substances, the concluding link, K, must be the lightest; its specific gravity is, indeed, only H = 1·00, K = 0·16 (water = 1·00, K = 0·86), H and K do not unite directly, on account of the disproportion of the mass of the H to that of the K molecule.

The multiple proportions of chemical combinations are, density being the active chemical principle, multiple of density, and, if this is made the measure of pressure, the condensations consequent on chemical union correspond to Mariotte's law.

The volume weight of H is = 1, that of O = 16; their densities are consequently 1·00 : 0·25 = 4 : 1. $4-1 = 3$ is the increase of force or pressure when the two elements react on each other, the reduction of volume or mass, consequently, $\frac{17}{3} = 5\frac{2}{3}$; $1+\frac{1}{2} = \frac{1}{2}$ is the increase of mass, that is, $\frac{17}{5} = 3\frac{2}{5}$. The sum of reduction and increase, $5\frac{2}{3}+3\frac{2}{5}$, is (within the fraction of $\frac{1}{15}$th) = 9, the volume weight of water, which is the product of the union.

1H, combining with 8O, unites with Fl 9·50, $d = 0{\cdot}324$; Cl 17·75, $d = 0{\cdot}237$; Br 40, $d = 0{\cdot}158$; I 63·5, $d = 0{\cdot}125$. The densities of these masses are to the unit H as $\frac{1}{9}, \frac{1}{4}, \frac{1}{8}, \frac{1}{8}$.

In kalium hydroxide the densities are multiple, if the composition is $H_2K_2(2\times19{\cdot}50 = 39)O(=8)$.

Densities—0·70, 0·16 . . . 0·35
$0{\cdot}70 = 2\times0{\cdot}35$
$0{\cdot}35 = 2\times0{\cdot}16$

In natrium hydroxide, if the composition is—
$HNa(=11{\cdot}50)O(=8)$.

Densities—1·00, 0·30 . . . 0·35
$1{\cdot}00 = 3\times0{\cdot}35-5$
$0{\cdot}35 = 0{\cdot}30+5.$

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ON A COLORIMETRIC METHOD FOR DETERMINING SMALL QUANTITIES OF COPPER.*

By THOMAS CARNELLEY, B.Sc., F.C.S.,
Demonstrator in the Chemical Laboratory of Owens College.

LAST year I brought before this Society a paper (*Proceedings*, vol. xiv., 2) on a colorimetric method for determining iron in waters, and as this method has been found convenient for estimating small quantities of iron in substances other than water,† I thought it would likewise be useful to have a delicate and easy method of a similar kind for copper, and it is the description of such a method that forms the subject of the present paper.

The reagent used is the same as in the case of iron, viz., potassium ferrocyanide, which gives a purple-brown colour with very dilute solutions of copper. This reaction, however, is not so delicate as it is with iron, for 1 part of the latter in 13,000,000 parts of water can be detected by means of potassium ferrocyanide, while 1 part of copper in a neutral solution, containing ammonium nitrate, can be easily detected in only 2,500,000 parts of water. Of the coloured reactions which copper gives with different reagents, those with sulphuretted hydrogen and potassium ferrocyanide are by far the most delicate, and as a preliminary, the comparative values of these two reagents were tested, with the following results, the determination being made in each case in 150 c.c. of water:—

(1.) *With* H_2S. 1 part of copper produces a colour in 2,500,000 parts of water.

(2.) *With* K_4FeCy_6.

(*a*.) In acid solutions, the colour produced being earthy brown, 1 part of copper produces a colour in 1,000,000 parts of water.

(*b*.) In neutral solutions, the colour being purple-brown, 1 part of copper produces a colour in 1,500,000 parts of water.

(*c*.) In neutral solutions containing ammonium nitrate, the colour being purple-brown, 1 part of copper produces a colour in 2,500,000 parts of water.

From the above it will be seen that of the two reagents sulphuretted hydrogen is the more delicate, except in the latter case, when they are of equal value. But potassium ferrocyanide has a decided advantage over sulphuretted hydrogen in the fact that lead, when not present in too large quantity, does not interfere with the depth of colour obtained, whereas to sulphuretted hydrogen it is, as is well known, very sensitive.

And though iron if present would, without special precaution being taken, prevent the determination of copper by means of potassium ferrocyanide, yet by the method as described below the amounts of these metals contained together in a solution can be estimated by this reagent.

As the above results show, ammonium nitrate renders the reaction much more delicate; other salts, as ammonium chloride and potassium nitrate, have likewise the same effect.

The method of analysis consists in the comparison of the purple-brown colours produced by adding to a solution of potassium ferrocyanide—first, a solution of copper of known strength, and secondly, the solution in which the copper is to be determined.

The solutions and materials required are as follows:—

(1.) *Standard copper solution.*—Prepared by dissolving 0·393 grm. of pure $CuSo_4.5H_2O$ in one litre of water. 1 c.c. is then equivalent to 0·1 m.grm. Cu.

(2.) *Solution of ammonium nitrate.*—Made by dissolving 100 grms. of the salt in one litre of water.

(3.) *Potassium ferrocyanide solution.*—Containing 1 part of the salt in 25 parts of water.

(4.) *Two glass cylinders* holding rather more than 150 c.c. each, the point equivalent to that volume being marked on the glass. They must, of course, both be of the same tint and as nearly colourless as possible.

(5.) *A burette*, marked to $\frac{1}{10}$ c.c., for the copper solution: a 5 c.c. pipette for the ammonium nitrate, and a small tube to deliver the potassium ferrocyanide in drops.

The following is the method of analysis:—Five drops of the potassium ferrocyanide are placed in each cylinder, and then a measured quantity of the neutral solution in which the copper is to be determined into one of them (A), and both filled up to the mark with distilled water, 5 c.c. of the ammonium nitrate solution added to each, and then the standard copper solution runs gradually into (B), till the colours in both cylinders are of the same depth, the liquid being well stirred after each addition. The number of cubic centimetres used are then read off. Each cubic centimetre corresponds to 0·1 m.grm. of copper, from which the amount of copper in the solution in question can be calculated.

The solution in which the copper is to be estimated must be neutral, for if it contains free acid the latter lessens the depth of colour and changes it from a purple brown to an earthy brown. If it should be acid it is rendered slightly alkaline with ammonia, and the excess of the latter got rid of by boiling. The solution must not be alkaline, as the brown coloration is soluble in ammonia and decomposed by potash; if it is alkaline from ammonia this is remedied as before by boiling it off; while free potash, should it be present, is neutralised by an acid and the latter by ammonia.

Within moderate limits the amount of potassium ferrocyanide does not affect the accuracy of the method, as was proved by several experiments, for instance, when $\frac{1}{2}$ c.c. and 2 c.c. of the ferrocyanide were added to the two cylinders respectively, water up to the mark, and 5 c.c. of ammonium nitrate to each, then 7 c.c. of the standard copper solution produced in each an equal depth in colour.

The same may be said of the ammonium nitrate, for in one of several trials, all leading to the same result, when there were five drops of ferrocyanide in each cylinder, with water up to the mark, and 5 c.c. of ammonium nitrate in one and 15 c.c, in the other, an equal depth of colour was obtained on running into each 7 c.c. of the standard copper solution.

The following are the results obtained by estimating the copper in pure solutions of copper sulphate of known strength:—

Copper found.	Copper calculated.
205·000 m.grm.	202·080 m.grm.
32·360 ,,	31·320 ,,
6·500 ,,	6·270 ,,
1·180 ,,	1·130 ,,
1·130 ,,	1·210 ,,
0·960 ,,	1·010 ,,
0·750 ,,	0·750 ,,
0·590 ,,	0·610 ,,
0·520 ,,	0·500 ,,
0·420 ,,	0·400 ,,
0·390 ,,	0·380 ,,
0·220 ,,	0·200 ,,
0·130 ,,	0·130 ,,
0·120 ,,	0·100 ,,
0·055 ,,	0·050 ,,

In order to test the effect which the different salts might have on the accuracy of the method, 8·0 grms. of a mixture of the following salts, viz.:—Ammonium chloride, sodium chloride, potassium nitrate, calcium chloride, calcium sulphate, and magnesium sulphate, were dissolved with an amount of copper sulphate, containing 0·101 grm. Cu. to 1 litre. Varying quantities of this solution were taken, and the copper estimated therein with the following results, from which it is seen that these salts have no detrimental effect:—

* A Paper read before the Manchester Literary and Philosophical Society.

† Among others I may mention that use has been made of this method by Wanklyn, in the indirect determination of alum in bread.—CHEMICAL NEWS, vol. xxxi., p. 67.

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Copper found.	Copper calculated.
0·54 m.grm.	0·51 m.grm.
0·71 ,,	0·71 ,,
0·91 ,,	0·91 ,,

In the same manner the effect of the presence of colourless non-volatile organic matter was tested by dissolving up 13 grms. of sugar with an amount of copper sulphate equivalent to 0·0505 grm. copper in 1 litre of water, and the copper estimated in two different portions as before, the following numbers being obtained:—

Copper found.	Copper calculated.
0·52 m.grm.	0·51 m.grm.
0·82 ,,	0·81 ,,

In order to see what influence the presence of lead might exercise on this method of estimating copper, a quantity of the sulphate containing 0·255 grm. Cu was dissolved in water, the copper precipitated by potash, washed, and the oxide dissolved in nitric acid and the solution after nearly neutralising with ammonia diluted to 1 litre with the addition of 2 grms. of lead nitrate = 1·25 grms. Pb. Varying quantities of this solution were taken, and the copper in them estimated with the following results:—

Copper found.	Copper calculated.
0·80 m.grm.	0·77 m.grm.
0·75 ,,	0·70 ,,
0·51 ,,	0·49 ,,
0·49 ,,	0·51 ,,
0·38 ,,	0·35 ,,

From which it will be seen that lead when present in not too large quantity has little or no effect on the accuracy of the method. The precipitate obtained on adding potassium ferrocyanide to a lead salt is white, and this, except when present in comparatively large quantity with respect to the copper, does not interfere with the comparison of the colours. In the above experiments the proportion of lead to copper was as 5 to 1.

When copper is to be estimated in a solution containing iron the following is the method of procedure to be adopted. To the solution a few drops of nitric acid are added in order to oxidise the iron, the liquid evaporated to a small bulk, and the iron precipitated by ammonia. Even when very small quantities of iron are present this can be done easily and completely if there is only a very small quantity of fluid. The precipitate of ferric oxide is then filtered off, washed once, dissolved in nitric acid and re-precipitated by ammonia, filtered, and washed. The iron precipitate is now free from copper, and in it the iron can be estimated by dissolving in nitric acid, making the solution nearly neutral with ammonia and determining the iron by the method given in the paper before referred to. The filtrate from the iron precipitate is boiled till all the ammonia is completely driven off, and the copper estimated in the solution so obtained as already described. The following are the results obtained with solutions containing known quantities of iron and copper:—

	Copper.		Iron.	
	Found.	Calculated.	Found.	Calculated.
(1)	0·53 m.grm.	0·51 m.grm.	0·22	0·20 m.grm.
(2)	0·69 ,,	0·61 ,,	2·15	2·40 ,,
(3)	0·79 ,,	0·76 ,,	2·42	3·00 ,,
(4)	0·66 ,,	0·66	—	—

When the solution containing copper is too dilute to give any colouration directly with potassium ferrocyanide, a measured quantity of it must be evaporated to a small bulk and filtered if necessary, and if it contains iron, also treated as already described.

In the determination of copper and iron in water, for which the method is specially applicable, a measured quantity is evaporated with a few drops of nitric acid to dryness, ignited to get rid of any organic matter that might colour the liquid, and dissolved in a little boiling water and a drop or two of nitric acid, if it is not all soluble it does not matter; ammonia is next added to precipitate the iron, the latter filtered off, washed, re-dissolved in nitric acid, and again precipitated by ammonia, filtered off, and washed. The filtrate is added to the one previously obtained, and the iron estimated in the precipitate and the copper in the united filtrate.

The distilled water used in the Owens College Laboratory, and which is condensed by the apparatus made by Hirzel, of Leipzig, gave, on analysis by the above method, the following results, two litres of the water being used for the purpose:—

0·15 parts Cu
0·03 parts Fe } in 1,000,000 parts of water.

The copper and iron in this case were evidently derived from the fittings of the condensing apparatus, which consisted in great part of these metals.

NOTE ON THE CHALYBEATE WATER AT SELLAFIELD, NEAR WHITEHAVEN.

By WILLIAM H. WATSON.

WHEN I published my examination of the chalybeate spring at Sellafield, near Whitehaven (CHEM. NEWS, xxxi., 11), I was unable to offer any idea as to the origin of the water or from whence it obtained its solid constituents. Since then I have been able to trace it, and find that the spring is supplied chiefly by drainage from fields in its immediate vicinity and partly by a small drain from a pond about half a mile distant. The water has to percolate through several yards of earth, which at about 5 feet from the surface and extending to a considerable depth below consists of a clayey soil containing both ferrous and manganous oxide, thus clearly indicating the origin of the chalybeate nature of the water previously analysed.

I append an analysis of a portion of the clayey earth dried at 212°.

Silica	40·24
Alumina	38·62
Ferrous oxide	10·73
Manganous oxide	0·70
Calcium carbonate	5·30
Calcium sulphate	2·05
Loss or undetermined	0·36
	100·00

ON SOME PRELIMINARY RESEARCHES ON THE ACTION OF METALLIC MAGNESIUM ON CERTAIN METALLIC SALTS.

By SERGIUS KERN, St. Petersburg.

DR. J. H. GLADSTONE'S very interesting paper on the copper-zinc couple inserted in the CHEMICAL NEWS, vol. xxxii., p. 195, gave me an idea to try the action of metallic magnesium on the aqueous solutions of certain metallic salts. The first salt which I took was cobalt chloride; the results of the experiments are as follows:—

A concentrated solution of cobalt chloride in water, with a piece of magnesium-ribbon, was placed into a tall glass. Evolution of hydrogen immediately commenced, and the solution was left to stand quietly in the laboratory for about a week; it was observed then that the evolution of hydrogen was nearly finished, and the solution was of a light rose colour. The magnesium ribbon during the experiments fell into pieces and was covered with a green mass. The solution was then stirred by means of a glass

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rod, and all the green mass fell down in the form of a precipitate, which was filtered from the liquor, washed, and dried over sulphuric acid. This peculiar precipitate was carefully examined as will be further explained.

From the remaining solution the excess of cobalt chloride was precipitated by $(NH_4)_2S$ in the form of cobalt sulphide. The CoS was filtered, and the clear solution obtained was tested for magnesium salts in case they were present; analysis showed the presence of this metal, so that a solution of sodium phosphate (HNa_2PO_4), with the addition of ammonia, gave in the analysed liquid a precipitate of ($MgNH_4PO_4$). The green mass examined under the microscope showed the presence of small pieces of undissolved magnesium, but most of the mass precipitated consisted of a green amorphous powder, which gives the following reactions:—

(1.) It is insoluble in water and alcohol.
(2.) With nitric acid it gives cobalt nitrate ($Co(NO_3)_2$).
(3.) Sulphuric acid yields the corresponding salt.
(4.) Ammonia colours it brown.

The substance was heated in a test-tube with sulphuric acid in order to obtain free hydrochloric acid in case chlorine were present in the green mass. Reagents showed the absence of chlorine.

This substance was found to contain a considerable amount of cobalt monoxide (CoO); it is formed during the experiments by the following reactions:—

$$CoCl_2+Mg+H_2O=CoO+MgCl_2+H_2.$$

This equation explains well, I suppose, the action of metallic magnesium on cobalt chloride.

When magnesium is thrown into a solution of silver nitrate, this salt is very quickly decomposed, with the formation of silver oxide (Ag_2O).

I conclude this short notice by remarking that Dr. Gladstone's new work opens to the chemist a new and very valuable method for chemical investigations.

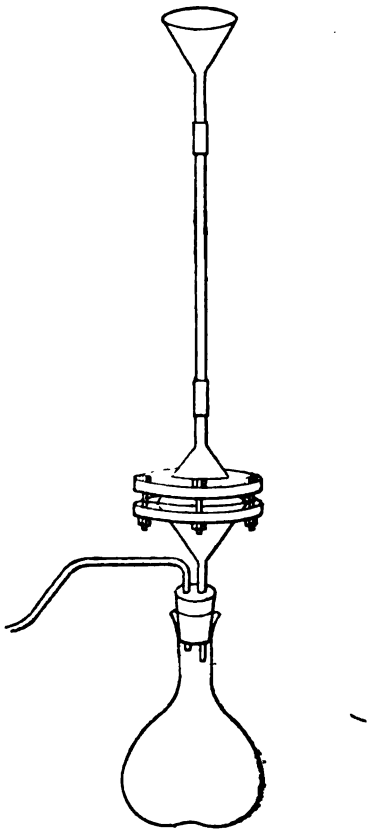
ON A SIMPLE APPARATUS FOR THE ESTIMATION OF TANNIC ACID BY THE METHOD OF MÜNTZ AND RAMSPACHER.

By WILLIAM THOMSON, F.C.S.

The method devised by Müntz and Ramspacher* is based on the fact that when a solution containing tannic acid is forced through well washed untanned hide, that the hide fixes all the tannic acid and practically allows the other matters which may be in solution to pass without being absorbed. The difference, therefore, between the specific gravities of the solution before and after passing through the hide indicates, by reference to a table, the percentage of tannin originally contained in the solution. The apparatus described by Müntz and Ramspacher is expensive, and the time required to have one constructed would no doubt be considerable, so that it would not be worth while for chemists who have not a somewhat regular practice in the analysis of tannin materials to go to the trouble or expense of having such an apparatus made. The principle of their contrivance consists in enclosing the fluid to be tested in a short metallic cylinder open at both ends, the under end being covered by a piece of the untanned hide, the upper by a strong piece of vulcanised sheet caoutchouc. These are clamped firmly together by screws, and by means of a screw to which is attached a rounded metallic disc pressure is brought to bear on the caoutchouc, and the fluid thus forced through the hide.

The contrivance which I have devised for this purpose, which answers perfectly, and may be made altogether in about an hour, is the following:—

Two strong ground-glass funnels with rather wide stems are taken, a circular piece of hard wood fitted on each (as shown in the drawing), the bottom part of which comes within the eighth of an inch from the top of the funnel; four holes are made through the wood, into which are inserted four ordinary long iron screws fitted with nuts; the hide is placed between the two funnels, the screws passed through the holes in the two pieces of wood, the nuts screwed on and tightened equally all round by a key; a funnel with a thin stem is then inserted into the larger stem of the top funnel and the liquor poured in; the stem of the under funnel is passed through an india-rubber cork fitted into a flask; the flask is



attached by another tube penetrating the cork to a Bunsen's vacuum pump, and vacuum made and the liquor allowed to filter slowly through. Quicker filtration may be produced by applying pressure above and suction below, by completely filling the upper funnel with liquid, attaching to its stem by strong caoutchouc tubing a long tube ending in another funnel (as shown in the engraving) and filling the tube and upper funnel with liquid; or the pressure by this means may alone be employed.

Royal Institution, Manchester,
December 20, 1875.

* *Annales de Chimie et de Physique*, September, 1875, p. 86.

Letts's Diaries.—According to their usual custom, Letts, Son, and Co. (Lim.) have issued a series of Diaries for the year 1876. To meet the requirements of all classes and professions, they seem each year to add to their already long list. The "Medical Diary," the "Appointment Diary," and the Commercial "Tablet Diary" are especially useful. A new feature of the Office Editions of these Diaries is the Lists of Provincial and Colonial and Foreign Post Towns, their distance from London (or Dublin), Market Days, Names of Bankers, and their London Agents, Number of Postal Deliveries and Despatches, &c.

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ULTRAMARINE: ITS FORMATION DURING THE INCINERATION OF BREAD.

By JAMES EDMUNDS, M.D., M.R.C.P.,
Medical Officer of Health, and Public Analyst for St. James's, Westminster.

I DO not find any note of the fact that, at a certain stage in the incineration of bread, the beautiful ultramarine blue is formed. This occurs under circumstances which I have not yet sufficiently studied to enable me to reproduce it with certainty; but, if the heat be raised to very bright redness or be prolonged after complete incineration of the bread, the blue passes into a beautiful turquoise colour, then becomes green, then passes on into a rusty colour, and finally comes out as a pale fawn-coloured lining to the botryoidal mass of ash. This is not further affected, even by a prolonged white heat. The tints are so suggestive of the presence of copper that only by very careful examination did I satisfy myself of the absence of that metal; and I find that the colours occur in the purest and finest bread, as well as in inferior samples. I should be grateful if other analysts would favour me with any observations which they may have made upon this point, and I hope soon to be in a position to submit for myself some further account.

It is curious that copper should appear in all the text-books as one of the agents ordinarily used for adulterating bread, and the question arises whether the supposed use of copper may not sometimes have been erroneously inferred from the occurrence in bread-ash of these beautiful colours.

5, Savile Row, London,
December 10, 1875.

ON NOXIOUS AND OFFENSIVE TRADES AND MANUFACTURES,*

WITH ESPECIAL REFERENCE TO THE BEST PRACTICABLE MEANS OF ABATING THE SEVERAL NUISANCES THEREFROM.

By H. LETHEBY, M.B., M.A., &c.;
Professor of Chemistry in the College of the London Hospital; late Medical Officer of Health and Public Analyst for the City of London; and President of the Society of Medical Officers of Health.

(Concluded from page 297).

THE last of the acid nuisances to which I shall refer is that caused by the manufacture of *superphosphate of lime*. In the early days of this branch of industry, it was the practice to make superphosphate of lime by mixing chamber acid a little diluted with water, with ground coprolites, bones, and animal refuse of all kinds, by means of a shovel and an open trough. The fumes of acid gases and vapours which were thus freely evolved into the air were extremely offensive to the neighbourhood. At present the mixture is effected in a closed vessel in which a stirrer revolves horizontally. The best form of mixer is about 10 feet long and 4 feet in diameter. The materials which are used in the manufacture are ground coprolites, crushed bones, spent animal charcoal from sugar refineries, and animal refuse of all kinds. These are put into the mixer in proper proportions, and treated with water and sulphuric acid. The mixer has an upper opening for the admission of the materials, and a lower one for the exit of them. Both of these openings are secured with air-tight valves; and during the mixing, which lasts from five to ten minutes, the materials evolve vapours charged with organic fumes as well as the acid, and exceedingly irritating tetrafluoride of silicon, which is produced by the action of sulphuric acid upon the fluorides and silicates contained in the coprolites. These gases and vapours are conveyed from the mixer by a special shaft or flue which carries them first to a chamber, in which they meet a copious spray of water, and then through a coke scrubber or condenser supplied with a stream of water; and lastly, in some cases, through a lime purifier before they reach the furnace shaft. When the materials are thoroughly incorporated in the mixer, they are discharged through the lower opening into the chamber or den, in which, in the course of twenty-four hours, they consolidate. This chamber should also be air-tight, and ventilated into the same shaft or flue which carries the gases from the mixer to the condenser. If these operations are properly managed, they may be conducted without other offence to the neighbourhood than the faint acid smell which is inseparable from the exposure of the consolidated superphosphate; but if they are not well designed and managed, they are the cause of insufferable nuisance. The object of having a fine spray of water as the first absorbent of the acid gases is that the tetrafluoride of silicon is immediately decomposed when it comes into contact with water, forming hydrate of silica, which is deposited in a pulpy form, and an acid called hydro-fluosilicic acid, which the water dissolves. Now, if this were to take place in a scrubber packed with coke and supplied with downward flowing water, this hydrate of silica would soon clog the pores and apertures of the scrubber, and throw it out of action. Hence the necessity for decomposing the tetrafluoride of silicon in a chamber before it reaches the coke scrubber.

And now, in concluding this brief outline of the processes which are most likely to receive attention from Medical Officers of Health, I may summarise the recommendations which I have ventured to submit as the best means of abating the nuisances referred to by saying:—

First, that all noxious and offensive operations should be carried on, as far as possible, in air-tight chambers, which can be ventilated by means of fans, or by the chimney draft.

Second, that all condensible and absorbable gases and vapours should be passed through condensers and absorbents best suited for their absorption—as water in spray, and scrubbers charged with water, oil of vitriol, or alkaline solutions.

Third, that, when necessary, these scrubbers should be supplemented with special purifiers, as hydrated oxide of iron, hydrate of lime, &c.

Fourth, that organic vapours and sulphuretted hydrogen and empyreumatic matters should be conveyed to the furnace fire and destroyed. In carrying out this part of the process it is necessary that all steam should be condensed from the vapours by cooling them thoroughly before they reach the fire, as otherwise the fire is apt to be put out by them. The fire which is best suited for this purpose is that which is actually used in manufacturing operations, as special fires are very likely to be neglected; and the best place for the entrance of the noxious vapours is at the back of the ash-pit immediately under the fire bars, as by this means a draft is secured (by closing the ash-pit), and the vapours are made to pass through the glowing coals of the fire.

Fifth, all offensive materials should be brought to the works, or carried away from them, in properly constructed carts or tanks, which can be closely covered; and all such material when stored at the works should be kept in close tanks or chambers, ventilated, when necessary, to the scrubbers or furnace fire.

Lastly, the whole of the operations should always be managed with care and attention to details—there being no neglect of the sound condition of every part of the plant or working apparatus.

With these precautions, which are by no means unreasonable or impracticable, the manufacturer of offen-

* A Paper read before the Society of Medical Officers of Health. Communicated by the Author,

sive products might generally so conduct his operations as not only to protect the public from annoyance, but also to secure his own interests by preventing unnecessary waste.

It will be observed that I have not dealt with the question of nuisances from the slaughtering of cattle, &c., as this has already received attention from the Society, through the labours of our colleague, Dr. Dudfield; in fact, our recommendations in this matter have been accepted by the Metropolitan Board of Works.

In conclusion, I trust that I may soon be able to find time for a further treatment of the subject by describing the nuisances which arise from the second and third causes alluded to at the beginning of the paper.

NOTICES OF BOOKS.

Milk in Health and Disease. By A. H. Smee. London: Printed by E. Newman.

This little work seems to have been written in order to throw discredit upon the process now usually adopted in the analysis of milk. As such it will doubtless be welcomed by all fraudulent dairymen, and not less by certain unscientific members of Parliament who have taken upon themselves to adjudicate on the "competence" of chemists. Now, we shall not assert that the process used in milk-analysis is absolutely perfect and incapable of improvement, but it has been adopted after an amount of careful experimental verification which may well be called enormous. Independent and eminent chemists up and down England and Ireland, in Sweden, in America, and elsewhere agree as to the practical uniformity of the "solids not fat," and consider the standard adopted by the public analysts to be well within the mark. Under these circumstances Mr. Smee must surely admit that the few dissentient statements must be received with grave suspicion. He seems to forget the real nature of the question put to public analysts concerning samples of milk laid before them, and to make, or rather insinuate, a charge of incompetence because they do not give further information. Thus, in summing up his results, he states—"That the methods now employed by public analysts are not sufficiently delicate to detect the minute physiological changes which may at times take place in so complex a fluid as milk." To this it is sufficient to reply that the public analyst, as such, has nothing to do with "minute physiological changes." He is simply asked, is such and such milk adulterated? Again, Mr. Smee has been informed, though upon what authority he does not state, that two tons of borax are sold annually for the purpose of adding to milk. This is a sufficiently loose statement. Where are the "two tons" sold? In all Europe, in England, or is this dose reserved for the especial use of London? He then resumes, that although so large a quantity, is sold annually to be added to milk, it is extraordinary that no analyst has recorded its presence and no prosecution has been instituted against offenders. *This fact has a tendency to throw discredit upon the analytical evidence upon which convictions for milk adulteration have been secured* (!) Let us now look a little more closely at these charges. Two tons may sound a large quantity; but it is not 13 lbs. daily. Divide this equally among all the milks sold in London, and it will make but an infinitesimal addition to the residue of ash in each case, especially if we remember that borax contains 47 per cent. of water. Or if it is only used by a few dealers, and has been but recently introduced, it is perfectly possible that no sample containing borax has come under the hands of a public analyst. If present, it would show itself by an increase in the proportion of ash to the other solids. But if the ordinary process of milk—without special examination of the ash—has failed to detect borax when present, the error tends to let rogues escape scot free, and not, as Mr. Smee most unjustifiably insinuates in the passage we have italicised, to the wrongful conviction of honest men. New methods of adulteration will, of course, spring up, and the skill of chemists will be tasked to keep pace with the depraved ingenuity of pushing tradesmen. But are we to censure the chemist who devised the process "commonly used by public analysts" for not giving special directions for the detection of a sophistication not then, if now, in use?

The variation in the total solids found in the milk of individual cows, even if well authenticated, is, as far as the detection of adulteration is concerned, not a point of great moment. What is the probability of a pint of milk as supplied by any dealer being entirely composed of the milk of one animal? We are struck with the small amount of fatty matter in the milk of short-horns, as shown in Mr. Smee's tables. This confirms the low estimation in which the breed was held in Lancashire and Westmoreland.

We find in this work two references to an alleged outbreak of enteric fever at Marylebone in 1873, which is said to have been "traced to milk obtained from a particular farm, the dairy utensils being washed with water contaminated with fever poison." Unfortunately, if we turn to the reports of the Registrar-General, we find that at the time of this epidemic the number of deaths from typhoid fever in Marylebone, instead of being in excess, was below the average for the season of the year. The man whose dejections are said to have poisoned the well died not from typhoid but from disease of the heart, as certified by two legally qualified medical men; and though the water was used for domestic purposes in the village, no outbreak of fever could be traced there.

But whilst we think that Mr. Smee is grievously astray in his remarks on milk analysis, we are much interested with the results he has obtained with the milk from cows fed upon sewage-grass. "The milk derived from the cow fed with sewage-grass went putrid and stank after thirty-six hours. The butter from sewage-grass fed milk became rapidly rancid compared with milk from cows fed on ordinary meadow-grass. The cream from ordinary grass required 35 mins., 1¼ hours, and ¾ hour to churn, and the butter was firm. That from sewage-grass required 1¼ hours, 1½ hours, 2½ hours, and the butter was soft and yeasty. These experiments were repeated with the milk from the same individual cows, and with other cows, but the results obtained were practically the same." The author also finds that hay made from sewage-grass when kept in a vessel of water in a warm place, sent up in a few days putrid fermentation, whilst ordinary grass treated in a similar did not. This agrees with the statement of Lefeldt that he had found unassimilated sewage-matters (Kloaken-stoffe) in the stems of grass from sewage-irrigation farms, and with our own observation that fish from rivers contaminated with sewage, *e.g.*, certain parts of the Thames above London, pass into putrefaction with exceptional rapidity. Mr. Smee's remarks ought to furnish a theme for meditation to certain enthusiasts of irrigation. There is something exceedingly appropriate in such a blow to the pet scheme of the late Rivers' Pollution Commissioners being administered in a book solemnly dedicated to the Chemist to the Commission.

CORRESPONDENCE.

THE RIVERS COMMISSION.

To the Editor of the Chemical News.

Sir,—Dr. Frankland has already expressed his obligation to your correspondent for calling attention to the experiments on sulphate of quinine described on page 505 of the Appendix to the Sixth Report of the Rivers Pollution Commission. Your correspondent will now call attention

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to an experiment on "Fresh Urine," described on page 9 of the Report, where fresh urine is represented as containing carbon and nitrogen, in the ratio of 0·99 of carbon to 1·00 part of nitrogen. This ratio cannot be correct, inasmuch as urea (the main organic constituent of urine) contains carbon and nitrogen in the proportion of 0·43 of carbon to 1·00 part of nitrogen.—I am, &c.,

J. ALFRED WANKLYN.

TESTING ALKALI.

To the Editor of the Chemical News.

SIR,—During the last twelve years I have tested some thousands of samples of soda-ash and caustic, against the Liverpool analysts. My experience is that their tests of high strength caustic are *perfectly correct*, as based upon the 32 equivalent; their returns for soda-ash, however, are nearly always 0·70 per cent too high.—I am, &c.,

SODA.

CHEMISTS AND THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—It has been pointed out (CHEMICAL NEWS, vol. xxxii., p. 251) that "perhaps degrees and diplomas may come, before long, to be judged according to the personal merit of their holders," and that men "must be estimated rather by their researches and writings."*

These views at least derive some weight from an incident that occurred at the meeting of the Chemical Society on the 2nd inst., when among the certificates read for the third time was one of E. A. Sturman, M.A., Ph.D. (Rostock), &c., Principal of Queen's College, Penge, Sydenham. His certificate was signed by three Fellows, from personal knowledge, who, on consulting the List of Fellows of the Chemical Society, we find to be all Doctors of Philosophy.

Mr. Charles T. Kingzett, in calling the attention of the Society to this certificate, read from *Figaro* of Nov. 24th the following passage:—"Professor Sturman, LL.D., of Packington College, 145, Packington Street, Islington, Secretary to *several* Foreign Universities, who prepares candidates by correspondence for B.A., M.A., Ph.D., LL.D., D.D., &c., and for legal and medical qualifications, &c., and who obtains titles of Chevalier and medals of Honour, &c., has, we are informed, done a roaring trade." In making this quotation Mr. Kingzett stated that he did not for one moment assert the identity of the candidate whose certificate had been read with the Dr. Sturman referred to by *Figaro*, but that, until the Society should be furnished with proofs of the non-identity, he considered it to be the duty of every Fellow present to vote against this candidate.

Any doubt that may exist as to identity would seem to be dispelled by the statement made to us by one of those Fellows of the Chemical Society who signed Dr. Sturman's certificate. This statement was to the effect that the candidate was the Dr. Sturman of Packington College! But the three gentlemen who signed Dr. Sturman's certificate, from personal knowledge, can surely give the necessary explanation.

Let us pass on from this matter to the general question of the elections at the Chemical Society.

The Chemical Society was founded for "the general advancement of chemical science," and it includes in its List of Fellows nearly all the best chemists in Great Britain; and that it prosecutes good work, and in a measure represents chemical science in England, is undoubted.

Now we do not consider the calling of a chemist and druggist, or of an apparatus-maker, or of a schoolmaster, to be incompatible with a knowledge of chemistry, but we do object to the acceptance of these callings *as* chemical qualifications. And supposing a man can adorn his name with twenty letters, what proof does this fact afford of his ability to advance chemical science? We do not hesitate to say that there are few men who are, at the same time, eminent theologians, good geologists, men of letters, and good chemists; and, as a rule, it may be taken that a man who boasts several professions is not worthy of all.

In short, we submit that no qualifications should be accepted at the Chemical Society but chemical qualifications, and it may be relied upon that if a man has them he will take care to state them upon his certificate.—I am, &c.,

A CHEMIST.

* Mr. Morgan has since informed us that he obtained his diploma after passing the usual examinations at Giessen.—*Ed. C. N.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. No. 22, November 29, 1875.

Memoir on the Organic Elements regarded as Electro-Motors.—M. Becquerel.—It appears, from the author's researches, that the interior of a muscle is negative, which indicates that there is oxidation in the interior and reduction at the exterior, and that all organised bodies appear formed of—so to say—an infinite number of electro-motors which intervene probably in the phenomena of nutrition.

Examination of a Wood Petrified with Subcarbonate of Lime found at Bourbonne-les-Bains.—M. Chevreul.—What is called petrifaction of a solid of organic origin comprises two distinct epochs when it is complete,—that is to say, when nothing more of an organic nature remains in the petrified solid. The first complete epoch comprehends the total occupation of all the interstices, all the pores of the solid by matter dissolved in a liquid. The second epoch comprehends the duration of the total disappearance of the organic matter itself, and its replacement by an inorganic matter which has penetrated it in a liquid state. It is this latter matter which represents the form of the organic matter.

Thermic Researches on Phosphoric Acid.—MM. Berthelot and Louguinine.—M. Thomsen, having repeated the experiments of Graham in 1869 (*Poggendorff's Annalen*, cxl., 90 and 94), concluded that phosphoric acid was not a true tribasic acid, but rather a bibasic and triatomic. The authors, having re-examined this subject, conclude that the three equivalents of base successively united with phosphoric acid are combined in different manners, the first being comparable to the base of the nitrates and chlorates, the second to that of the carbonates and borates, and the third to the base of the alkaline alcoholates.

Observations on the Composition of the Arable Soils of Auvergne: Importance of Phosphoric Acid as regards their Fertility.—M. P. Truchot.—After examining the granitic and volcanic soils of Auvergne, the author concludes, with M. P. de Gasparin, that phosphoric acid rather than potash gives the measure of the fertility of a soil.

Contraction Produced by Interrupting the Current of the Battery in the case of Unipolar Excitement of the Nerves.—M. A. Chauveau.—This memoir would be unintelligible without the accompanying illustrations.

Crystalline Sulph-hydrocarbide obtained from the Interior of a Mass of Meteoric Iron.—Lawrence Smith.—In the study of meteoric graphites, with which the author is engaged, an observation made during the combustion of graphite in oxygen led him to suspect the

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presence of a hydrocarbide like that discovered by M. Woehler in the meteorites of Kaba and Cold Bohevelde, and subsequently by Roscoe in the meteorite of Alais. On treating graphite obtained from the interior of the meteoric iron of Sevier Co., Tenn., with ether, he obtained a small quantity of acicular crystals, of a peculiar odour, mixed with some small rounded points. The experiments made upon these crystals demonstrate their identity with those described by Prof. Roscoe before the Philosophical Society of Manchester, February 24th, 1863. L. Smith proposes for this body the name Celestialite.

M. Reimann's Farber Zeitung, No 45, 1875.

This number contains a paper on the uses of sulphate of magnesia in dyeing, under which the writer points out that it is sometimes added to a dye-beck to raise its boiling-point. Sometimes it is often used to form by double decomposition sulphates of certain tinctorial bases, especially the aniline colours, which are then more easily fixed upon the fibre than the corresponding hydrochlorates. Sulphate of magnesia is also added in woollen-dyeing to certain colours which are to bear fulling. A. Frank, of Stassfurt, points out that cotton goods are sometimes weighted with sulphate of magnesia to the extent of 53 per cent. This treatment he denounces as fraudulent, but it is defended by M. Reimann, who, however, protests against the use of chloride of magnesium for the same purpose, as being injurious to the fibre.

There are further receipts for a grey, and a black, on silk garments; a blue on half-woollen tissues; a dark blue for loose wool, fast and fugitive; for printing a grey, red, and a violet on half-silks; and for a black on linen yarn.

Revue Universelle des Mines, de la Metallurgie, de Travaux Publics, des Sciences et des Arts Appliques a l'Industrie, September and October, 1875.

The only chemical notices in this issue are taken from the *Comptes Rendus*.

Les Mondes, Revue Hebdomadaire des Sciences, No. 13, November 25, 1875.

Here we find a notice of the life of "Anne Toussainte de Volnire, called the "Saint of Néant."

In a note on guano, we read that the accumulations of guano on the Chincha Islands are generally considered as composed of the excrements of sea-fowl. In reality they consist of two portions, differing both in the manner and the epoch of their origin. The upper layer, much the less considerable, is formed of the excrements and dead bodies of birds and of seals, which at present inhabit the islands in question. The lower bed has been formed in præhistoric ages from the excrements of birds which have fallen to the bottom of the sea, of which they inhabit but a limited portion. The strata thus formed have been subsequentiy upheaved.

An article of nine pages, headed "Natural History," should rather have been entitled an essay on the operations of Catholic missionaries in China and India.

The paper on "Acetimetry," by MM. O. Reveil and Salleron, has been already noticed.

M. Maumené very justly condemns Baumé's hydrometer.

M. Durand, of Blois, proposes to preserve eggs by coating them with silicate of soda.

The papers on the electrolytic formation of aniline black, or on the distinction between artificial alizarin and extract of madder, as existing upon printed calico, have already been noticed.

From the *Transactions* of the Academy of Sciences at Stockholm for 1875, No. 3, p. 83, is taken an account of rainbows intersecting each other, as observed by M. Gumœlius at Nya Kopparberg, June 19, 1874.

December 2, 1875.

The editor gives the rules of the Scientific Society of Brussels, a recently-formed body, whose object is to cause science to "continue the series of his glorious advances without ever rising in insurrection against the faith, with this profound conviction, that every fact, every theory in contradiction with the faith is necessarily false (*tant pis pour les faits!*), and consequently unscientific." The 10th article declares that the Society "shall never permit any attack, even if courteous, against the Catholic religion or the spiritualist and religious philosophy."

The next article contains the text of the law on the "liberty" of superior instruction in medicine. This is followed by a paper, entitled the "old and new faculties of medicine, which occupies ten pages, and does not possess the slightest scientific interest. The only chemical matter in this issue is a reproduction of the memoir on ozone, read by Dr. T. Andrews before the Royal Society of Edinburgh.

Moniteur Scientifique, du Dr. Quesneville, December, 1875.

Products of the Decomposition of Castor Oil.—M. E. Neison.—Translated from the *Journal of the Chemical Society*.

Theory of Luminous Flames.—M. Charles Heumann.—A flame may be rendered non-luminous by reduction of temperature; by dilution with inert gases; and by energetic destruction (oxidation) of the luminous matter. The luminous power may be restored by a supply of heat; by the elevation of the temperature of the flame by heating the gaseous mixture, or the inert gas alone, in a tube of incandescent platinum before its ignition; and by rarefying the oxygen with an inert gas.

Account of Chemical Progress.—M. A. Macquet.—This paper includes a notice of an elementary work on inorganic chemistry by M. E. Grimaux; a translation of two memoirs on paraffin, from the *Journal of the Chemical Society*; a note by M. Chautard on the spectrum of chlorophyll; and a memoir by M. E. Bourgoin on the identity of the bromated derivatives of tetrabromide of ethylen with those of the perbromide of ethylen, noticed long ago.

Facts Relative to the Study of the Polyatomic Alcohols, properly so-called.—M. Lorin.—Already noticed.

Note on the Determination of Caffeine.—M. A. Commaille.—Already noticed.

Separation of Cholesterin from Fatty Matters.—A. Commaille.—The author saponifies the fatty matter with caustic soda, and after cooling and dissolving the saponaceous mass in water, agitates with ether, which on evaporation deposits cholesterin in flakes.

Central-Blatt fur Agrikultur Chemie, Heft 10, October, 1875.

Amount of Water Evaporating in the Open Air.—C. von Sonklar.—The amount of evaporation at different seasons of the year depends primarily on the temperature, but in an inferior degree on the amount of atmospheric moisture.

Influence of Forests upon Climate.—L. Fautrat.—Taken from *Comptes Rendus*.

Influence of Manuring with Superphosphate upon Quality and Yield of Hay.—Dr. J. König.—The author finds that a dressing of superphosphate improves the quality and quantity of hay produced on barren irrigation-meadows.

Influence of Limestone on the Distribution of the so-called Calcifugous Plants.—Ch. Contejean.—Taken from *Comptes Rendus*.

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Mineral Constituents of Lucerne.—P. v. Gasparin.—Former analyses of the ash of lucerne showed a very high amount of soda. The author, however, finds only 0·915 per cent, though the filtered subsoil water contained 50 m.grms. in a decalitre.

Presence of Copper in Juniper Liqueur, Brandy, and Dung.—Dr. A. Petermann.—The author traces copper in juniper- and corn-spirit, and even in the dung of cattle fed with the spent grains from the distilleries.

NOTES AND QUERIES.

Synthesis of Tannin.—I have made many attempts to convert gallic into tannic acid by digesting with arsenic acid as described in *Chem. Soc. Jour.*, vol. xii., p. 269, but so far without any success. I have digested with large and small quantities of arsenic acid in aqueous and alcoholic solution for four or five days together at boiling temperature, but have been unable to detect a trace of tannin even with acetate of copper and ammonic carbonate, while abundance of gallic acid has crystallised out on cooling. If any chemist who has succeeded will point out my source of failure I shall be exceedingly obliged.—HENRY R. PROCTER, Preston, North Shields.

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INDEX.

ABSORPTION phenomena of
arable soils, 226
Acclimatisation and change of
soil, 193
Acetic acid in the cold, oxidation
of, 239
Acetylen, derivatives of, 147
Acid, distribution of an, among
several bases in solution, 50
Adulteration, detection of, 77, 297
of guano, 84
Air compressed, influence of on
fermentations, 51
"Air, Examinations of in Smok-
ing Cars" (review), 27
Air, ozone in the, 42
Albumen, blood, 8
quantitative determination of
in animal fluids, 180
Albumenoid bodies, constitution
of, 158
Alcohol, action of iodide of me-
thyl upon, 52
toxic properties of, 84
"Alcoholic Liquors, Chemical
Examination of" (review),
154
Alcohols, reduction of aldehyds
to, 57
Aldehyds, reduction of to alco-
hols, 57
"Alizarin and Oxyanthrachinon'
(review), 144
formation of by reduction of
rufigallic acid, 260
from anthracen-sulpho-acid, 241
Alkali, testing, 313
Alkalies in the ashes of plants,
chemical equivalence of the,
51
Alkaloids in the aconites, 232
Allen, A. H., chemistry applied
to the detection of adultera-
tion, 77
Alloy of chrome-iron, 136
of copper adhering to glass, 146
Alloys, metallic, 63
"American Contributions to Che-
mistry" (review), 143
Amido-caprylic acid, 41
Ammonia, apparatus for the ab-
sorption of, 40
amount of in the air, 226
in sea waters, 226
manufacture of sulphate of,
224, 238
potash and soda, solubility and
dissociation of bicarbonates
of, 9
Ammonium, radical, 152
Analysis of minium or red lead, 3
of sugar, 145
Analysts, Society of Public, 26,
38, 49, 58, 80, 100, 109, 140,
153, 166, 189, 203, 213, 235, 244
Andoynaud, M., researches on the
ammonia contained in sea
waters, and in those of the
salt marshes of the district of
Montpellier, 220
Andrews, J., variations in the
composition of river waters,
299
Andrews, T., analysis of the sul-
phur well, Ballynahinch Spa,
65
experiments on gases under
high pressures, 145
further researches on the phy-
sical properties of matter in
the liquid and gaseous states
under varied conditions of
pressure and temperature,
43, 53
Angelic acid, bibromide of, 8
Angell, A., improvements in but-
ter analysis, 69
Aniline-black, formation of by
the electrolysis of its salts,
168
Aniline colours, production of
without arsenic acid, 146
its reaction with chloride of
sulphur, 180
Antimony and bismuth, decom-
position of the trichlorides of,
229
iodides of, 232
Amyline, action of upon dichlor-
hydrin, 51
Armstrong, H. E., action of po-
tassic sulphite on the haloid
derivatives, 298
Aromatic series, decomposition
of certain compounds of the,
by potassic chlorate and hy-
drochloric acid, 61
Arsenic acid, production of ari-
line colours without the use
of, 146
and phosphorus fluorides, 258
detection of in animal matters,
289
localisation of in the various
tissues of poisoned animals,
130
use of in the production of ani-
line colours, 84
Ashe, T., "Medical Politics, being
the Essay to which was
awarded the First Carmichael
Prize of £200 by the Council
of the Royal College of Sur-
geons, Ireland" (review),
223
Askenasy, E., temperature which
plants assume in sunshine,
250
Asparagin of the Leguminosæ
into an albumenoid, supposed
transformation of, 62
Assay of cloth dyed Turkey-red,
20
"Atmosphere, Composition of
Ground" (review), 27
Atmospheric pressure and rain-
fall, influence of upon the
subsoil water, 72
Atomic weight of copper, 9
of the cerium metals, 176
weights when arranged in their
natural order, relation among
the, 21
Attfield, J., "Chemistry: Gene-
ral, Medical, and Pharma-
ceutical" (review), 236
Auerbach, G., alizarin from an-
thracen-sulpho-acid, 241, 254
Aymonet, M., study of the cold
bands of obscure spectra, 168

BAIRD, S. F., "Annual Record
of Science and Industry for
1874" (review), 27
Bancoul, nuts of, 61
Barbier, M. P., fluoren and its
derivative alcohol, 8
Barstow, M., sulphurets, what they
are, how concentrated, how
assayed, and how worked, 236
Baryta green, 158
Beckett, G. H., alkaloids con-
tained in the aconites, 232
narcotine, cotarnine, and hy-
drocotarnine, 275, 298
Becquerel, H., magnetic rotary
polarisation, 4
measure of affinities in the mu-
tual reactions of two solu-
tions, taking the electro-
motor forces as bases, 210
organic elements regarded as
electro-motors, 313
Beer, adulteration of, 102
Beet-root, purchase of based on
the density of the juice, 103
Beghin and Mène, MM., analysis
of coal in Island of Sudera, 8
Bel, J. A. le, reactions of the ho-
mologues of ethylen, which
may explain their absence in
natural petroleums, 303
Bell, C. A., potassium cyanate
and urea, 99
J. C., manufacture of sulphate
of ammonia, 224
water analysis, 246
Bender C., gas given off by
apples, 227
Benedikt, R., phlorein, hæmatin,
and brasilein, 147
Bert, M. P., influence of com-
pressed air upon fermenta-
tions, 51
Berthelot, M., acetates of ammo-
nia, 104
direct union of propylen with
the hydracids, 104
distribution of an acid among
several bases in solution, 50
synthesis of camphors by the
oxidation of camphenes, 18
thermic researches on citric
acid, 302
on phosphoric acid, 313
Besson, P. P., some compounds
of ether with anhydrous me-
tallic chlorides, 299
Betteili, C., oleandrine and so-
called pseudocurarin, 157
Bibliography of the history of
chemistry, 36, 56, 68
Bibromide of angelic acid, 8
Bindschedler, M., manufacture of
eosine, 198
Bismuth compounds, 277
decomposition of the trichlor-
ides of, 229
Blanshard, C. T., position and
character of mercury and
copper, founded upon their
atomic weights, 151
Bleaching-powder, calcic hypo-
chlorite from, 22
Blondeau, C., ferments and fer-
mentations, 249
Blood, 41
albumen, 8
transformation of into soluble
powder, properties of, 204
"Blowpipe, a Guide to its Use in
the Determination of Salts
and Minerals" (review), 191
Blunt, T. P, analysis of minium
or red lead, 3
Blyth, A. W., milk of the cow in
disease, 244
Piper Nigrum, 140
Boiler incrustations, 9
Boisbaudran, M. L. de, discovery
of a new metal, gallium, 159
Bolley, P. A., "Manuel Pratique
d'Essais et de Recherches
Chimiques Appliqués aux
Arts et a l'Industrie" (review),
236
Bolton, H. C., bibliography of
the History of chemistry, 36,
56, 68
birth of chemistry, 281
Bondonneau, L., saccharification
of amylaceous matters, 281
Bones, composition of, 72
Boracic acid, fused, and on
temper, 71
Bouchardat, G., products of the
dry distillation of caoutchouc,
146
synthesis of a terpilene or
camphenic carbide, 19
Boug, G., prussiates, 259
Bourgoin, C., chlorobromated
ethylen, isomerism of its
chloride with the bromide of
perchlorated ethylen, 61
Boussingault, M., limits of the
carburation of iron, 9
Brasilein, 147
Bread, formation of ultramarine
during the incineration of,
311
new method of producing, 42
British Association, 114
Brugger, M., experiments on the
yield of hemp, 72
Brush, G. J., "Mauual of Deter-
minative Mineralogy, with an
Introduction on Blowpipe
Analysis" (review), 60
Brown, J. C., solids in milk, 28
Bruhn, M., experiments on the
yield of plots of land treated
with artificial manures as
compared with unmanured
plots, 72
Brussels, Scientific Society of, 314
Bunsen's burner, new form of, 267
Busch, M., manufacture of eosine,
198
Bussey Institution, Bulletin of
the" (review), 60

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Butlerow, H. A., penta-methyl-o-thol and its derivatives, 51
Bütschli, C., chitin, 72
Butter, 102

CAFFEINE and its solubility, 276
Calcium chloride, nature of at Guy's Cliff, 277
Calvert, F. C., "Dyeing and Calico-Printing" (review), 300
Camphene, transformation of into camphor, and camphor into camphene, 8
Camphenes, synthesis of camphor by the oxidation of, 18
Camphenic carbide, synthesis of, 19
Camphor into camphene, and camphene into camphor, transformation of, 8
preparation of crystalline monobromated, 145
Camphors, synthesis of by the oxidation of camphenes, 18
Carton dioxide, liquid, presence of in mineral cavities, 258
disulphide, purification of, 163
protosulphide of, 60
Carburation of iron, limits of, 9
Carnelly, T., colorimetric method for determining small quantities of copper, 308
tolyl-phenyl, a new hydrocarbon, 232
Casamajor, P., funnels with auxiliary vertical tubes, 183
implement for filtration, 33, 45
Caustic soda, 30
manufacture of white, 164, 174, 186, 198, 210, 225, 238, 247, 248
Cech, C. O., diethylic ether of xantho-acetic acid, 84
Cécil, M., new method of producing bread, 42
Cerium metals, atomic weight of the, 176
Chalk, importance of in madder dyeing, 158
Chalybeate water from a spring at Sellafield, analysis of, 11, 309
Champion, P., nitro-citric acid, 292
sulphides and phosphides of copper, 291
use of Fehling's liquor, 291
Chancel, G., gum of wine, and its influence upon the determination of glucose, 61
Charcoal, animal, analysis of, 276
Chautard, J., magneto-chemical phenomena produced in a medium of rarefied gases in Geissler's tubes, 71
Chauveau, A., contraction produced by interrupting the current of the battery in case of unipolar excitement of the nerves, 313
unipolar electric excitement of the nerves: comparison of the activity of the two poles during the passage of the current s of the battery, 259
Chemical action, nature and laws of, 306
Chemical and Geological Essays" (review), 7
Chemical and spectroscopic characters of a new metal, Gallium, 159
arts during the last ten years, development of, 5, 11, 25, 54, 65, 78, 99, 108, 138, 153, 164, 174, 184, 202, 219, 230, 241, 255, 265, 276, 285
science, 99
"Chemistry, Dictionary of" (review), 143
"Chemistry, General, Medical, and Pharmaceutical" (review), 236
'Chemistry, How to Teach it, being the substance of Six Lectures at the Royal College of Chemistry, June, 1872" (review), 80
Chemistry, history of, 144
"Chemistry, Nature and Elements of" (review), 39
Chemistry, outlines of a bibliography of the History of, 56
Chemists and the Chemical Society, 213
Chevreul, M., examination of wood petrified with subcarbonate of lime, 313
Chinese oil tree, fatty matter in the seed of, 179
Chinidin, test for sulphate of, 41
Chitin, 72
Chittenden, R. H., glycogen and glycocoll in the muscular tissue of Pecten irradians, 66
Chloride of silver battery with 3243 elements, 239
sulphur, reaction of with aniline, 180
Chlorides of alcoholic radicals on the primary and secondary monamines, 146
Chlorinated methyl and ethyl ethers, chemical constitution of, 242, 255
Chlorine, hydrate of, 62
action of on isobutyl-hydriodic ether, 62
Cholesterin, separation of from fatty matters, 314
Chrome-iron alloy, 136
Chromeisen and other alloys, 265
Chrome, phosphate of, 62
Citric acid, 302
Clæsson, J. P., phenylo-sulphacetic and ethylo-sulphacetic acids, 8
Clapham, R. C., visit to chemical works in France, 274
Clark, J. W., further observations on the spectra of lightning, 65
Clay, blue matter in, 113
Clermont, M. J., presence of the peroxide of hydrogen in the sap of plants, 51
Cloëz, M. S., fatty matter of the seed of the Chinese oil-tree, 179
Cloth factories, refuse water from, 158
Coal, analysis of in Island of Sudera, 8
in Russia, 79
Cobalt and nickel, 76, 260
detection of nickel and, 102
Cochrane, M. H., filtering cones, 8
Cochineal in the Canary Islands, 169
Cold bands of obscure spectra, 168
Collins, J. H., crystallography, 248
Mineralogical Society, 113, 156, 225
water analysis, 258
Colorimetric method for determining small quantities of copper, 308
Colorimetric study of the silicides of iron and manganese, 173
Commaille, A., determination of caffeine and on its solubility, 271
process for separating cholesterin from fatty matters, 271, 314
Commercial analysis, 238
Commission, the rivers, 312
Compressed powders, magnets formed with, 103
Cones, filtering, 8
Constant temperature, method of obtaining a, 31
Copper, alloy of adhering to glass, 146
and mercury, position and character of, founded upon their atomic weights, 151
atomic weight of, 9
colorimetric method for determining small quantities of, 308
presence of in juniper liqueur, brandy, and dung, 315
Copper-zinc couple and its effects, 75
action of the, 150
Copying pencils, 30
Coquillion, M. J. J., formation of aniline-black by the electrolysis of its salts, 168
Corenwinder, B., nuts of Bancoul, 61
Cossa, A., germination of seeds in nitrous oxide, 193
Cottrine, 298
Cotton, mordants for dyeing, 30
Cresol from oxuvitic acid, 83
Croullerois, M., rotatory power of quartz in the ultra-violet spectrum, 239
Crystallisation, 41
Crystallography, 225, 248, 281

DAVIS, G. E., manufacture of white caustic soda, 166, 174, 186, 198, 210, 238, 248
Davies, J. L., chemistry in Swansea, 270
Davies, R. H., detection of nickel and cobalt, 102
potassium ferro- and ferricyanide for the detection of nickel and cobalt, 44
Davy, H. M., amount of ammonia in atmosphere, 226
Debray, H., specific gravity of pure platinum and iridium and their alloys, 281
Delachanal, B., new spectro-electric tube, 249
compound of platinum, tin, oxygen, analogous to the purple of Cassius, 157
Demarcay, E., bibromide of angelic acid, 8
Desains, M., study of the cold bands of obscure spectra, 168
Devill, Ste.-Claire H., specific gravity of pure platinum and iridium and their alloys, 281
Diaries, Letts's, 310
Dibbets, H. C., solubility and dissociation of bicarbonates of potash, soda, and ammonia, 9
Dechlorhydrin, action of aniline upon, 51
"Dictionary of Chemistry" (review), 143
Dietrich, E., examination of French red wines for genuiness of colour, 193
Th., weathering of the soil under various external influences, 226
"Digest of the Reported Cases Relating to the Law and Practice of Letters Patent for Inventions" (review), 70
Dilatation of the specific heat of alloys, and their relations with the law of Dulong and Petit, 180
"Discoveries and Inventions of the Nineteenth Century" (review), 245
Dissociation of salts containing water, 226
sulpho-carbonate of potassium in presence of ammoniacal salts, 8
Distilled water, lead in, 82
Dita bark, 41, 146
Dividing instruments, method of measuring refractive indices without the use of, 54
Domeyko, M., telluric minerals recently discovered in Chili, 226
two new meteorites from the Desert of Atacama, with observations on the meteorites hitherto found in that part of South America, 218
Duchartre, P., remarks on the interpretation of two tables of chemical analyses, 302
Duclaux, E., separation of mixed liquids, and on new maximum and minimum thermometers, 270
Duffet, H., electro-conductibility of pyrites, 226
Duffy, P., melting points of fats, 27
Dupré, A., influence of phosphoric and oxalic acids on the colour of sulpho-cyanide and meconate of iron, 15
Durin, M., commercial analysis of sugars and influence of salts and of glucose on crystallisation of sugar, 226
Durin, M., purchase of beet-root based upon the density of the juice, 103
"Dye Drugs used for Colouring Wines, Detection of" (review), 178
"Dyeing and Calico Printing (review), 300
"Dyeing and Dyeing Receipts, Manual of" (review), 101
Dyeing, uses of sulphate of magnesia in, 314

EDME, E. S., construction of lightning conductors, 303
Edmunds, J., ultramarine: its formation during the incineration of bread, 311
Eggs, preservation of with silicate of soda, 314
Eichhorn, M., absorption phenomena of arable soils, 226
Electrical resistance of liquids, method of measuring, 13
Electric force, new phase of, 305
polarisation of minerals, 156
Electro-conductibility of moderate conductors, 168, 169, 204, 239, 259
Electrolytic oxygen on glycerin, 84
Electro-motors, organic elements regarded as, 313
"Elements and Nature of Chemistry" (review), 39
Elements, relation among the atomic weights of the, when arranged in their natural order, 21
organic, regarded as electro-motors, 313
Emetine, 72
Engel, R., taurine, 8, 41
English work, 236
Eosine, manufacture of, 198
Ergotium, a new alkaloid found in the ergot of rye, 282
Esilman, A., manufacture of sulphate of ammonia, 224, 238
purification of brown sulphate of ammonia, 197
Essential oils, oxidation of the, 138
Ethyl-phenyl-acetylen, 257
Ethylen and other polyamines, mono-character of, 1
chloro-bromated, 61
Ethylic alcohols in the vegetable kingdoms, 62
Ethylo-sulphacetic and phenylo-sulphacetic acids, 8
Euchlorines, 19

FAIRLEY, T., new alkali and oxide of uranium, 219
Fats, melting-points of, 27
Fatty oil, detection of the falsification of, 146
Feil, C., researches on tempered glass, 156
Fermentations, influence of compressed air on, 51
Fermentation-vat, improvement in the, 194
Ferments and Fermentations, 243
Field, C. L., chemical nomenclature, 270
"Fifth Annual Report of the Deputy-Master of the Mint" (review), 154
Filtering cones, 8
Filtration, implements for, 33, 45
Flames, luminous, theory of, 314
Fleitmann, M., determination of small quantities of cobalt in nickel, 260
filtration, 260

Fleury, G., researches on the inversion of cane-sugar by acids and salts, 271
thermic phenomenon which accompanies "inversion," 84
Fluoren and its derivative alcohol, 8
Fluorides of arsenic, and phosphorus, 258
phosphorus, and iodine, 232
Foot and mouth disease, 301
Force, electric, new phase of, 305
Fontheim, M., action of tolylic acid as a medicament, 180
Fox, C., pollution of rivers, 229
Frankland, E., "How to Teach Chemistry" (review), 80
Rivers' Commission, 279
Freire, D., new process for the determination of free oxygen in urine, 103
Friedel, C., certain alterations in agates and flints, 303
certain compounds of titanium, 281
compound of methylic oxide and hydrochloric acid, 83
molecular combinations, 107
Funnels with auxiliary vertical tubes, 183

GALLIUM, chemical and spectroscopic characters of, 159
certain properties of, 293, 294
Galvanic current, action of on the organs of sensation, 20, 40
Gas from apples, 227
supply, metropolis, 31
Gases evolved on the Island of St. Paul, 156
under high pressures, 145
Gasparin, P. v., mineral constituents of lucerne, 315
Gatehouse, J. W., rapid mode of detecting the adulteration of butter with other fats, 297
Gaugain, J. M., on magnetism, 83
process of magnetisation, 61
Gautier, A., detection and determination of arsenic contained in animal matters, 259
blood, 41
Gawalowski, A., beet-root treacle as a manure, 72
Gerlich, G., pseudo-propyl-rhodanide and allyl-rhodanide, 147
Gilding, 30
Girard, C., action of the chlorides of alcoholic radicals on the primary and secondary monamines, 146
mordants for dyeing cotton, 30
Girard, A., pyrites used in France in the manufacture of sulphuric acid, 84
Girouard, E., tempered glass, 62
Gladstone, J. H., augmentation of the chemical activity of aluminium by contact with a more negative metal, 180
copper-zinc couple and its effects, 75, 150, 195
decomposition of alcohol and its homologues by the joint action of aluminium and its halogen compounds, 277
Glass, tempered, 62
Grénard, A., emetine, 72
Glycerin, electrolytic oxygen on, 84
Glycogen and glycocoll in the muscular tissue of Pecten irradians, 66
Gold, new reagent for, 171
Goppelsroeder, M., electrolysis of bodies of the aromatic series, 303
Gramp, F., determination of nitric acid in water, 260
Graphite, analysis of from Siberia, 229
Grete, C. A., meta-brom-toluol, 52
Grimaux, M. E., synthetic researches on the uric group, 156
Groves's method of preparing chloride of ethyl and its homologues, 61
Groves, C. E., incense resin, 277
Grosham, J. A., "Nature and Elements of Chemistry" (review), 39
Guano, note on, 314
substance used to adulterate, 84
Guareschi, T., preliminary note on parabanic and oxaluric acids, 73
products of the action of urea upon asparagin and aspartic acid, 73
Guerin, J., certain compounds of titanium, 281
Guthrie, F., fundamental water waves in cylindrical vessels, 14
staticnary liquid waves, 266
Gypsum, deposit of in Southern Utah, 56

HABERLANDT, M., acclimatisation and change of seed, 193
Hæmatin, 147
Hæmoglobin, reactions of, 179
Haigh, E., potato disease and the curl disease in potatoes, 191
Hampe, W., atomic weight of copper, 9
Harcourt, A. G. V., address to Chemical Section of British Association, 105
Harrow, G., action of potassic sulphite on the haloid derivatives, 298
Harvey, J. W. C., incrustation of an old flue, 252
Hartley, W. N., presence of liquid carbon dioxide in mineral cavities, 258
Hartwig, F., thallium with alcohol radicals, 40
Haubst, P., derivative of the hydrocarbon valerylene, 252
Hautefeuille, P., calorimetric study of the silicides of iron and manganese, 113
Hawkshaw, Sir John, Address as President of British Association, 87
Hayes, A. A., wide diffusion of vanadium, and its association with phosphorus in many rocks, 34
Heckel, E., oil of Bankoul, 157
Hempel, W., volumetric determination of sulphuric acid in waters, 259
Hesse, O., dita bark, 41, 146
test for sulphate of chinidin, 41
Heumann, C., theory of luminous flames, 314
Heynsius, A., quantitative determination of albumen in animal fluids, 180
Higgins, C., digest of the reported cases relating to the law and practice of letters patent for inventions, 70
High-pressures, gases under, 145
Hilger, M., selenite of magnesia, 9
Hiller, A., chemical composition of the Löss formation, 250
Hofmann, A. W., development of the chemical arts during the last ten years, 4, 11, 25, 54, 65, 78, 99, 108, 138, 153, 164, 174, 184, 202, 219, 231, 241, 255, 265, 276, 285
Hosäus, A., constituents and physical properties of pond soils, 193
Hunt, T. S., "Chemical and Geological Essays" (review), 7
Husson, C., certain reactions of hæmoglotin and its derivatives, 179
Hydracids, direct union of propylen with, 104
Hydrocarbon valerylene, derivative of, 252
formed on the distillation of crude fatty acids in presence of superheated steam, 50
Hydrocotarnine, 298
Hydrogen peroxide in the sap of plants, 51
Hydrometer, Baumé's, 314
Hydrosulphite vat, 9
Hypochlorite, calcic, from bleaching-powder, 22
Hypochlorous acids, 19

INCENSE resin, 277
Incrustation of an old flue, 252
Incrustations, boiler, 9
Indices, method of measuring refractive, without the use of dividing instruments, 54
Inductive power of insulants, specific, 20
Instruction, royal commission on scientific, 137, 149
Insulants, specific inductive power of, 20
Inversion of cane-sugar by acids and salts, 271
Irish Universities, 123
Iron, limits of the carburation of, 9
meteoric, 221
sulph-hydrocarbide obtained from mass of, 313
pyrites, 41
Isonylamid, 40

JAMIN'S magnets, supporting power of, 51
Jamin, J., distribution of magnetism in a thin plate of great length, 50
in bundles of infinite length composed of very slender laminæ, 60
magnets formed with compressed powders, 103
Jean, F., preparation of tungsten, and the composition of wolfram, 72, 249
substance used to adulterate guano, 84
Jobst, J., Dita bark, 146
Johnson, G. S., certain sources of error in the ultimate analysis of organic substances containing nitrogen, 277
decomposition of stearic acid by distillation under pressure, 231
Joly, A., researches on the niobates and tantalates, 113
Jones, E. W. T., adulteration of beer, 102
G., blood albumen, 8

KÆMMERER, H., method of discovering the presence of nitrous and of nitric acids in water, 14
Kainite used as manure, 226
Kern, S., action of sulpho-cyanides on palladium chloride and nitrate, 242
of metallic magnesium on certain metallic salts, 309
analysis of graphite from Siberia, 229
chrome alloy, 136
chromeisen, and on some other alloys, 265
coal in Russia, 79
estimation of manganese in spiegeleisen, iron, and steel, 100
Mineralogical Society, 145
new reagent for gold, 171
preparation of strontium sulphide, 157
purification of carbon disulphide, 163
radical ammonium, 152
Kingzett, C. T., calcic hypochlorite from bleaching-powder, 22
oxidation of the essential oils, 138
König, J., composition of the clay and greywacke slate of Westphalia, and of the soils produced by its decomposition, 239
König, J., influence of manuring with superphosphate upon quality and yield of hay, 314
Kopfer, F., action of mineral acids upon chloride of lime, 62
Kopp, E., "Manuel Pratique d'Essai et Recherches Chimiques appliqués aux Arts et a l'Industrie" (review), 236
chemical products at the Vienna Exhibition, 19
Kraut, K., dissociation of salts containing water, 226
Kurtz, J., removal of alkalies from the animal system, 72

LABORATORY instruction and chemical lectures, 117
Landolph, F., new derivatives of anethol, 72
Lauber, E., ebony-black stain for wood, 260
Lead in distilled water, 82
Le Bon, G., transformation of blood into a soluble powder, and the chemical, physical, and alimentary (!) properties of this powder, 204
Lectures, chemical and laboratory instruction, 117
Lehmann, J., modification of nitrogen most suitable for the nutrition of plants, 193
Lescœur, H., gyratory movement of certain salts on the surface of water, 259
Letheby, H., noxious and offensive trades and manufactures, 263, 273, 284, 295, 311
Lévy, A., amount of ammonia in atmosphere, 226
Lievrite, 227
Lightning-conductor for powder-magazines, 18
observations on the spectra of, 65
Lime, action of mineral acids on chloride of, 62
in mortars, proportion of, 82
nature of chloride of, 19
salts of bones, 193
Lindbom, C. G., salts of trimeta-phosphoric acid, 8
Litmus, tincture of, 62
Loewe, J., tannic acid of divi-divi, 260
tannin of Hungarian galls, 261
L'Olivier, M. V., nitrate of soda trade of South America, 249
Louguinine, W., correspondence from St. Petersburg, 8, 260, 292
researches on citric acid, 302
thermic researches on phosphoric acid, 313
Lorin, M., study of the polyatomic acids, properly so-called, 114
Löss formation, chemical composition of, 250
Luck, E., combination of the peroxide of nitrogen with the phosphate of magnesium, 9
Luff, A. P., detection of cobalt and nickel, 71
Luminous flames, theory of, 314
Lunge, G., analysis of burnt pyrites, 30
Luynes, V. de, fused boracic acid, and on its temper, 71
researches on tempered glass, 156

MACHATTIE, A. T., deposit of gypsum in Southern Utah, 56
MacIvor, R. W. E., action of phosphorus pentachloride on acetamide, 152
decomposition of the trichlorides of antimony and bismuth, 229
estimation of arsenic, 283
fluorides of arsenic and phosphorus, 258
phosphorus, and iodine, 232
"Magic Lanterns: How Made and How Used" (review), 245

Digitized by Google

Magnesia in drinking water, 136
selenite of, 9
sulphate of, uses of in dyeing, 314
Magnesium, action of on certain metallic salts, 309
Magnetic rotary polarisation, 4
Magnetisation, processes of, 61, 225
Magnetism, 83
distribution of in a thin plate of great weight, 50
Magneto-electric machine, new form of, 14
Magnets formed with compressed powders, 103
Mallet, J. W., notes of work in the University of Virginia, 160
Maly, B., digestion of albumen, 72
Manganese in spiegeleisen, iron, and steel, 100
"Manuel Pratique d'Essais et de Récherch s Chimiques appliqués aux Arts et à l'Industrie" (review), 236
Manufactures and trades, noxious and offensive, 263, 273, 311
Manurial experiments with barley, 193
Märcker, M., composition of washed wool, 72
Markovnikoff, V., laws which govern the reactions of direct addition, 239
Mathematical and physical science section, address to, 131
Matter, blue, found in clay, 113
Maumené, E. J., different amounts of heat produced by the mixture of olive oil with concentrated sulphuric acid, according as the latter has been more or less recently boiled, 217
"Medicine, a Retrospect of" (review), 60
Méhay, M., base of oxidation of acetic acid in the cold, in neutral or feebly alkaline liquids, in presence of nitrates and phosphates of soda and potash, 239
Meister, H., phosphorites of Samland, 193
Mellilotol, 25
Mendeleef, D., discovery of gallium, 293
Mène and Beghin, MM., analysis of coal in the Island of Sudera, 8
Mensel, M., putrefaction produced by bacteria in presence of alkaline nitrates, 204
Mercadante, M., concurrence of albumen in render ng tricalcic phosphate soluble in the blood, 157
formation of sugar in fruits, 19
supposed transformation of the asparagin of the Leguminosæ into albumenoid, 62
vegetation of Oxalis acetosella, Rumex acetosa, and R. acetosella in a soil devoid of potash, 73
Mercury and copper, position and character of, founded upon their atomic weights, 151
Mermet, A., certain double metallic sulpho-carbonates, 157
compound of platinum, tin, and oxygen, analogous to the purple of Cassius (platinostannic oxide of M. Dumas), 157
new spectro-electric tube, 249
reactions for distinguishing the sulpho-carbonates of the monosulphide, MS,CS_2, from those of the bisulphide, MS_2CS_2, 291
reagent proper for detecting the sulpho-carbonates in sodium, 157
very sensitive reagent for detecting the sulpho-carbonates of monosulphide (MS,CS_2) in solution, 291
Merrick, J. M., milk question, 60
Meta-brom-toluol, 52
Metallic alloys, 63
Meteoric iron that fell in Dickson Co., Tenn, in 1835, 221
Meteorites, two new, from the Desert of Atacama, 218
Methods of analysing commercial products, 169
Methylic oxide and hydrochloric acid, 83
Methyl, iodide of upon alcohol, 52
Metropolitan gas, 227
Micrometer for spectroscopic analysis, new form of, 14
Milk question, 60
solids in, 28
"Milk in Health and Disease" (review), 312
Mineralogical Society, 29, 71, 81, 112, 113, 145, 155, 168, 225
"Mineralogy, Manual of Determinative, with Introduction to Blowpipe Analysis" (review), 60
Minerals, doubtful, 15
Minium or red lead, analysis of, 3
Molecular combinations, 107
Molybdic acid, volumetric determination of, 259
Moncel, M. Th. du, note on the electric conductivity of bodies of medium conducting power, 156, 168, 204, 239, 259
Mono character of ethylen and other polyamines, 1
Moore, E., milk solids, 50
Mordants for dyeing cotton, 30
Morgan, T. M., ethyl-phenylen-acetylen, 257
Morin, H., pyrites used in France in the manufacture of sulphuric acid, 84
Morton, H., non-retreating Bunsen burner, 251
Moschini, M., manurial experiments with barley, 193
Mouchot, A., the industrial application of solar rays, 217
Muir, M. M. P., certain bismuth compounds, 277
Müller, A., assay of cloth dyed Turkey-red, 20
Müller, H., chloride of silver battery of 3240 elements, 239
Müller, J., antiseptic properties of salicylic and phenic acids, 85
Murexan, nature of, 171
Mutschler, L., chemical composition of the Löss formation, 250

Naphthalin colour, new, 62
Napier, J., "Manual of Dyeing and Dyeing Receipts" (review), 101
Narcotine, 298
cotarnine, and hydro-cotarnine, 257
Natural and artificial organic products, distinction between, 83
Neauber, M., varieties in analytical chemistry, 180
Nebulæ, spiral, 249
Nelson, E., sebates of the alcohol series, 298
Neubauer, C., antiseptic action of salicylic acid, 179
Newlands, J. A. R., relations among the atomic weights of the elements when arranged in their natural order, 21, 192
Nicholl, W. R., "Composition of the Ground Atmosphere, with some Examination of the Air in Smoking-Cars" (review), 27
Nicholson, E., calculation of the proportion of lime in mortars, 82
Estimation of nitrates in water, 163
Nickel and cobalt, detection of, 102
use of potassium ferrocyanide and ferricyanide for the detection of, 44
Niobates and tantalates, 113
Nitrate of soda trade of South America, 249
Nitric acid in water, 260
on tribromo-phenol, 298
Nitrites in water, 163
Nitrogenous matter used as manure, analysis of, 20
Noctilucine, the phosphorescent principle of luminous animals, 220
Nomenclature, chemical, 248, 270
Noxious and offensive trades and manufactures, 295, 311
Nowack, A. F., influence of atmospheric pressure of rainfall upon the subsoil water, 72

Obituary, Dr. R. Schenck, 204
Ogilvie, T. M., estimation of phosphoric acid as ammonio-magnesian phosphate, 5, 12, 70
Oils, essential, oxidation of, 138
Oleandrine and pseudocurarin, 157
Opl, C., nature of chloride of lime, and on its spontaneous decomposition, 19
Oppenheim, M., oxuvitic acid, and the cresol derived from it, 83
"Organic Analysis, Outlines of Proximate" (review), 40
Organic products, distinction between natural and artificial, 83
Oxidation of the essential oils, 138
sulphur, 62
Oxuvitic acid, and cresol from it, 83
"Oxyanthrachinon and Alizarin" (review), 144
Ozone in the air, 42

Page, F. J. M., gas regulator, 232
Para-sulpho-benzoic acid, 227
Parnell, E. W., estimation of phosphoric acid, 222
Parsons, W. C., lead in distilled water, 82
Pasteur, M. L., distinction between natural and artificial organic products, 83
Patents, 10, 52, 181, 261
Patent law, our, 112
Pawolleck, B., substitution-products of citric acid, and an attempt at its synthesis, 227
Peat, 233
Pekelharing, C. A., determination of urea in the blood and in the tissues, 180
Pelal, L., investigations on hypochlorous acid and on chlorines, 19
Pellet, H., nitro-citric acid, 292
sulphides and phosphides of copper, 291
use of Fehling's liquor, 291
Penta-methyl-athol and its derivatives, 51
Perkin, W. H., formation of coumarin, cinnamic acid, and other similar acids, 258
Peroxide of iron as a generator of nitric acid, 157
hydrogen in the atmosphere, 193
nitrogen, combination with phosphate of magnesium, 9
Persulpho-cyanogen, thiammeline, a new derivative of, 8
Pesa, L., peroxide of iron as a generator of nitric acid, and on the origin of nitre in some experiments of Cloëz, 157
Pettenkofer, M., ozone in the air, 42
Petermann, A., presence of copper in juniper liqueur, brandy, and dung, 315
Pfaff, S., oxuvitic acid, and the cresol derived from it, 83
Pfaundler, L., unequal solubility of different faces of the same crystal, 29
Phenylo-sulphacetic acid and ethylo-sulphacetic acids, 8
Phillips, S. E., atomic weight of the cerium metals, 176
constitution of uric acid, 209
mono character of ethylen and other polyamines, 1
Phipson, T. L., action of the galvanic current on the organs of sensation, 29
magnetisation of ilmenite (titanic ironstone), 162
mellilotol, 25
noctilucine, the phosphorescent principle of luminous animals, 220
Phlorein, 147
Phosphoric acid and potash in commercial products, 159, 172, 185, 193, 200, 208, 223
as ammonio-magnesian phosphate, estimation of, 5, 12, 70
estimated by the blowpipe, 217
estimation of, 222
importance of as regards fertility of arable soils of Auvergne, 313
thermic researches on, 313
Phosphorous acid, determination of, 66
Phosphorous its association with vanadium in many rocks, 34
pentachloride on acetamide, 152
Physical properties of matter in the liquid and gaseous states under varied conditions of temperature and pressure, 43, 53
Physics, instruction in at South Kensington, 124
Pierce, F., physiological action of the ethyl compounds, 257
Pierre, S., exhaustion of the soil by apple trees, 270
Piesse, C. H., milk question, 49
Piper nigrum, 140
Planté, G., phenomena produced by electric currents of high potential, 84
spiral nebulæ, 249
Platinum in sulphuric acid during the industrial process of concentration, 284
pure, specific gravity of, and of iridium and their alloys, 281
tin, and oxygen, compound of, analogous to the purple of Cassius, 157
Plympton, G. W., "Blowpipe: a Guide to its Use in the Determination of Salts and Minerals" (review), 191
Polarisation, magnetic rotary, 4
Pollacci, E., oxidation of sulphur, 62
Pollution of rivers, 229
Ponomareff, J., thiammeline, a new derivative of persulphocyanogen, 8
Potash and phosphoric acid in commercial products, 159, 172, 185, 193, 200, 208, 223
in presence of soda, estimation of by the blowpipe, 237
soda, and ammonia, solubility and dissociation of bicarbonates of, 9
Potassium cyanate and urea, 99
ferro- and ferri-cyanide for the detection of nickel and cobalt, 44
"Potato Disease, and the Curl Disease in Potatoes, their Cure and Prevention" (review), 191
Pouchet, A. G., review of the methods of analysing commercial products, 160
Precht, H., determination of phosphorous acid, and on the composition of the phosphate of baryta, 61
dissociation of salts containing water, 226
Prescott, A. B., chemical examination of alcoholic liquors, 154
"Outlines of Proximate Organic Analysis" (review), 40

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Prinzhorn, A., determination of phosphorous acid, and on the composition of the phosphite of baryta, 61
Procedure, new, for the determination of free oxygen in urine, 103
Programme of the Royal Rhenish Westphalian Polytechnic School at Aachen, 81
Proteic bodies, 62
Protzen, M., boiler incrustations, 9
Propylen with hydracids, direct union of, 104
Prunier, M., action of chlorine upon isobutyl-hydriodic ether, 51
Prussiates, 259
Public Analysts, Society of, 6, 15, 26, 38, 49, 58, 69, 80, 100, 109, 140, 151, 166, 187, 203, 213, 235, 244
Pyrites, analysis of burnt, 30
electro-conductivity of, 226
iron, 41
used in France in the making of sulphuric acid, 84
Pyrology, 254
"Pyrology, or Fire Chemistry," (review), 59

RAMSAY, W., bismuthiferous tesseral pyrites, 278
Readwin, T. A., crystallography, 225, 281
Mineralogical Society, 71, 112, 145, 156, 168
Reagent for gold, 171
Red lead or minium, analysis of, 3
Renard, A., action of electrolytic oxygen upon glycerin, 84
Reoch, J., nature of murexan, 171
Resistance, electrical, of liquids, means of estimating, 13
Ribau, J., transformation of camphor into camphene and camphenes into camphor, 8
Richter, O., chemical constitution of ethers, 242, 255
Richter, Th., "Plattner's Manual of Qualitative and Quantitative Analysis with the Blowpipe," (review), 81
Rivers' commission, 268, 279
pollution of, 229
River-waters, 299
changes in, 219
variations in the composition of, 207
Rodwell, G. F., history of chemistry, 144
Romer, P., Turkey reds with artificial alizarin, 73
Rommier, M., dissociation of sulpho-carbonate of potassium in the presence of ammoniacal salts, 8
Ross, W. A., estimation of phosphoric acid by the blowpipe, 217
potash in presence of soda by the blowpipe, 237
pyrological combination of zinc with hydric metaphosphate, 283
pyrology, or analysis and synthesis by means of the blowpipe, 254
or fire chemistry, 59
pyroxidation of silver, 83
Rostcski, E., amidoid derivatives of hydroxylamin, cinnamhydroxamic acid, and dicinnam-hydroxamic acid, 227
Rotary magnetic polarisation, 4
Rotatory power of quartz in the ultra-violet spectrum, 239
Routledge, R., "Discoveries and Inventions of the Nineteenth Century" (review), 245
Royal Society, 240, 272
Rudler, F. W., Mineralogical Society, 81
Rue, W. de la, chloride of silver battery of 3240 elements, 239

SABANEJEFF, A., derivatives of acetylen, 147
Salicylic acid, 46
antiseptic action of, 179
in titration, 269
Salt, soap direct from, 152
Salts, action of metallic magnesium on certain metallic, 309
of trimeta-phosphoric acid, 8
Scheurer-Kestner, M., solution of platinum in sulphuric acid during the industrial process of concentration, 281
Schiff, H., action of aniline upon dichlorhydrin, 51
hydrate of chlorine, 62
synthesis of sulphuretted tannins, 227
Schmidt, A., milk, 250
Schöne E., peroxide of hydrogen in the atmosphere, 193
Schorlemmer, C., Groves's method of preparing chloride of ethyl and its homologues, 61
reduction of aldehyds to alcohols, 57
Schreder, J., decomposition of certain compounds of the aromatic series by chlorate of potash and hydrochloric acid, 61
Schutzenberger, M., researches on the constitution of the albumenoid bodies, 158
"Science and Industry, Annual Record of for 1874" (review), 27
Science at the Univerities, 144
Scott, J. H., Sale of Food and Drugs Act (1875), 109
Sebates of the alcohol series, 298
Selenite of magnesia, 9
Separation of mixed liquids, 270
Sestini, F., action of chloride of acetyl upon santonic acid and upon santonin, 19
certain property of ferric orthophosphate, 68
Sewage as nutriment for crops, 42
Sidot, M., protosulphide of carbon, 60
Silicides of iron and manganese, calorimetric study of, 113
Silliman, B., American contributions to chemistry, 143
Silva, R. D., reducing action of hydriodic acid at low temperatures, 156
Silver, pyroxidation of, 83
Silvestri, O., chemical decomposition: dissociation applied to the interpretation of certain volcanic phenomena; synthesis and analysis of a new mineral from Etna, and of common origin in volcanos, 157
Simpkin, S. J., estimation of tannic acid, 11
"Siphoid can" for petroleum oils, 9
Sipöoz, L., lievrite, 227
Smee, A. H., "Milk in Health and Disease" (review), 312
Smith, J. A. R., reaction of chloride of sulphur with aniline, 180
Smith, J. L., crystalline sulphydrocarbide obtained from interior of a mass of meteoric iron, 313
description and analysis of a mass of meteoric iron fallen in Dickson county, Tennessee, 72
mass of meteoric iron that fell in Dickson County, Tennessee, in 1835, 221
true mineralogical and chemical place of triolite, 303
R. A., study of peat, 233
R. F., manufacture of sulphate of ammonia, 280
Soap direct from common salt, 152
Soda-ash, testing, 281
Soda, caustic, 30
potash, and ammonia, solubility and dissociation of bicarbonates of, 9
tests, Liverpool, 302
Solubility, unequal, of the different faces of the same crystals, 29
Souklar, C. von, amount of water evaporating in the open air, 314
Source, L. M. de la, action of water on uric acid, 29
Spectra of lightning, observations on the, 65
Spectro-electric tubes, 249
Spectrum of yttrium, didymium, and lanthanum, 30
Spiegeleisen, iron, and steel, manganese in, 100
Spiller, J., occurrence of native calcium chloride at Guy's Cliff, 277
Spring, W., dilatation and the specific heat of alloys, 180
Squibb, E. R., note on salicylic acid, 46
Stearic acid, decomposition of by distillation under pressure, 231
Steiner, A., diethylic ether of xantho-acetic acid, 84
Stenhouse, J., incense resin, 277
Stettin poisoning case, 169
Stevenson, T., milk question, 49
Stewart, B., Address to Mathematical and Physical Science Section of British Association, 131
G. C., analysis of animal charcoal, 276
sugar analysis, 258
Stierlin, R., notes on the detection of dye-drugs used for colouring wines, 178
Stilben, distillation of, 227
Stœcker, A., Wildungen, its baths and mineral springs, 191
Stone, W. H., galvanic current on the organs of sensation, action of the, 40
thermopiles, 244
Strontium sulphide, preparation of, 137
Sugar analysis, note on, 45, 225. 226, 248, 258
in fruits, 19
Sulphate of ammonia, 216
brown, purification of, 197
manufacture of, 224, 238, 258, 269, 281
reform in manufacture of, 192
Sulph-hydrocarbide obtained from mass of meteoric iron, 313
Sulphide of strontium, preparation of, 137
Sulpho-carbonate of potassium, dissociation of in presence of ammoniacal salts, 8
Sulpho-carbonates, 145
Sulpho-cyanides, action of on palladium chlorides and nitrate, 241
Sulphur, oxidation of, 62
well, analysis of, 65
"Sulphurets, what they are, how Concentrated, and how Worked" (review), 236
Sulphuretted tannins, synthesis of, 227
Sulphuric acid in waters, volumetric determination of, 259
production of, 150
Supporting power of Jamin's magnets, 51
Symons, W. H., adoption of a symbol to signify the application of heat for use in equations of chemical reactions, 221

TALEN, R., spectrum of yttrium, didymium, and lanthanum, 30
Tannic acid, estimation of, 11, 310
of divi-divi, 260
Tannin, synthesis of, 315
Tantalates and niobates, 113
Tauret, Ch., new alkaloid, ergotinin, found in the ergot of rye, 282
Taurin, researches on, 8, 41
Telluric minerals in Chili, 225
Temper of fused boracic acid, 71
Tempered glass, 62, 156
Terpenes, isomeric, 231
Terpilene or camphenic arbide, synthesis of, 19
Thallium compounds with alcohol radicals, 40
Thenard, P., notice of a blue matter found in clay, 113
Thermopiles, 244
Thiammeline, a new derivative of persulpho-cyanogen, 8
Thomas, J. W., diseased milk, 269
Thomson, W., estimation of tannic acid by method of Müntz and Ramspacher, 310
Thompson, L., our patent law, 112
Thorp, W., Rivers' Commission, 280
Tin, separation of from antimony and arsenic, 260
Tisley, S. C., new form of magneto-electric machine, 14
Tissandier, M. G., existence of ferruginous and magnetic particles in the atmospheric dust, 218
Titanium, compounds of, 281
Tolyl-phenyl, 232
Trève, M., influence of magnetism upon the extra current, 51
Tribe, A., decomposition of alcohol and its homologues by the joint action of aluminium and its halogen compounds, 277
Trimeta phosphoric acid, salts of, 8
Troost, M., calorimetric study of the silicides of iron and manganese, 113
Truchot, P., fixation of atmospheric nitrogen in soils, 303
importance of phosphoric acid as regards fertility of arable soils of Auvergne, 313
Tschermak, J., dichlorethlyamin 292
Tungsten, preparation of, 72, 219
Turkey-reds with artificial alizarin, 73

ULTRAMARINE: its formation during the incineration of bread, 311
Unipolar electric excitement of the nerves, 259
Uranium, new oxide and acid of, 219
Urea, action of upon asparagin, products of, 73, 195
and potassium cyanate, 99
in the blood and tissues, 180
Uric acid, action of water on, 29
constitution of, 209
group, 156
Urine, oxygen in, 103

VANADIUM, wide diffusion of, 34
Vat, the hydrosulphite, 9
Vegetation, action of upon the physical attributes of the soil, 193
Velain, C., analysis of the gases evolved in the Island of St Paul, 156
Vertical tubes, auxiliary, funnels with, 183
Viedt, Ch., copying pencils, 30
Vienna Exhibition, chemical products at the, 19
Violette, C., influence of stripping off the leaves upon the vegetation of the sugar beet, 218
Vogel, E., nature and laws of chemical action, 306
Volumetric determination of molybdic acid, 259
estimation of chlorides, and the presence of alkaline phosphates, 6

WANKLYN, J. A., Mr. Allen on butter, 102
changes in river waters, 219

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Wanklyn, J. A., determination of magnesia in drinking-water, 136
milk analysis, 49
Rivers' Commission, 268, 290, 312
variations in the composition of river-waters, 207
Warner, G., Liverpool soda tests, 291
Washed wool, 73
Water, action of on uric acid, 29
amount of evaporating in the open air, 314
analysis of, 248, 258
chalybeate, at Sellafield, 309
determination of magnesia in drinking, 136
nitrites in, 163
Watts, H., "Dictionary of Chemistry" (review), 143
Watson, W. H., analysis of chalybeate water from a spring at Sellafield, near Whitehaven, 11, 309
Watts, W. M., new form of micrometer for use in spectroscope analysis, 14
Weber, R., influence of locality on the composition of the ash of the larch, 72
Weiske, H., composition of bones during variations in food, 72
salicylic acid in titration, 249
Wernicke, A., volumetric determination of molybdic acid, 259
Wheatstone, Sir Charles, obituary notice of, 213
Whitelaw, T. N., soap direct from common salt, 152
Widman, O., formation of alizarin by the reduction of rufigallic acid, 260
Wigner, G. W., Sale of Food and Drugs Act (1875), 109
tea, 116, 189, 235
"Wildungen; its Baths and Mineral Springs" (review), 191
Willgerrodt, C., alizarin and oxyanthrachinon, 144
Wilson, W. J., method of measuring electrical resistance of liquids, 13
Wine, gum of, 61
Winkler, C., separation of tin from antimony and arsenic, 260
Wischnegradsky, A., three new pinacolins, 147
Wolfhügel, M., ozone in the air, 42
Woltram, composition of, 72
Wollny, M., action of vegetation upon the physical attributes of the soil, 193
Wood petrified with subcarbonate of lime, examination of, 313
Wood, A. A., magic lanterns, how made and how used, 245
W. H., Science at the Universities, 144
Wright, C. R. A., alkaloids contained in the aconites, 232
isomeric terpenes and their derivatives, 231
Liverpool soda-tests, 302
narcotine, cotarnine, and hydrocotarnine, 257, 298
structural formulæ of narcotine and its derivatives, 257

YOUNG, W. C., volumetric estimation of chlorides, and the presence of alkaline and phosphates, 6

END OF VOLUME XXXII.

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